February 2008

Pavement Analysis and Design

Derek Caldwell
Worcester Polytechnic Institute

Jennifer E. Gilbert
Worcester Polytechnic Institute

Ryan J. Trunko
Worcester Polytechnic Institute

Project Number: CE-RBM-0702

Pavement Analysis and Design for the State of Maine
A Major Qualifying Project Report:
submitted to the Faculty
of the
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by

Derek Caldwell

Jennifer Gilbert

Ryan Trunko

Date: February 29, 2008

Approved:

Professor Rajib B. Mallick

Abstract

This study analyzes a current pavement structure in Guilford, Maine and designs a new, more economical pavement structure for the site. The pavement data was obtained with a number of in-situ instruments, which were installed in conjunction with the Maine Department of Transportation, and analyzed using pavement analysis programs. This study examines both theoretical and empirical traffic loading and environmental changes to efficiently design new pavement structures.

Capstone Design Report

The capstone design requirement for our MQP was fulfilled by designing a suitable pavement structure for Maine, with the considerations of appropriate traffic, temperature conditions, and properties of materials.

Acknowledgments

The group would like to thank our advisor Rajib B. Mallick for all the advice and guidance he gave during the project, Christine Conron, who at the same time was completing a graduate independent study concerning similar topics, for her timely help, Donald Pellegrino for his technical support and Professor Mingjiang Tao for additional resources.

We would also like to thank Timothy Soucie, Lauren Swett, Josh Schmitt and Ron Cote from the Maine Department of Transportation for their help in getting us the necessary information to complete this project.

Authorship Page

This report has been contributed to equally by all members involved. The Literature review section was completed and edited by all members. The section of the report regarding calculated strains in the pavement was mainly completed by Jennifer Gilbert. The section about the strain given by the instrumentation on site as well as the technical descriptions of the project was completed by Derek Caldwell. The section of the report devoted to the design of a pavement was completed by Ryan Trunko. The final results and conclusions for the report were completed equally.

Derek Caldwell

Jennifer Gilbert

Ryan Trunko

Table of Contents

List of Figures

List of Tables

1. Introduction

Most pavements used in the United States are designed using American Association of State Highway and Transportation Officials (AASHTO) design standards which are not site specific and are becoming rapidly outdated for the current traffic levels which exist on most roads. It is necessary to have pavements designed regionally with appropriate environmental conditions taken into account, rather than using generalized pavement research.

This project utilizes a pavement test site in Guilford, ME. The road experiences a large percentage of trucks as part of its daily traffic loadings. The Maine Department of Transportation (MDOT) is utilizing multiple test sites around the state to research current pavement conditions and see if changes should be made. This enables the MDOT to perform research which is very specific to roads across the state and therefore may be able to produce a pavement which is designed for maximum performance at the specific areas.

This project uses the data collected at this test site. The data collected includes environmental, pavement responses as well as data acquired from a weigh in motion sensor which is able to determine a vehicles weight and class. Using the environmental data and the data acquired from the WIM equipment it is possible to calculate theoretically the stresses and strains responses of the the pavement for any given combination of temperature and vehicle type. These calculated numbers can be compared to the ‘actual’ response data from the site.

Combining the results allows for a very site specific and accurate pavement design which will hopefully allow for less maintenance and longer life of the pavement in the region. Through the longer life of a well designed pavement, the state will have to spend less money on projects to repair the pavement. If the majority of pavements throughout the state were designed on a site specific basis this would potentially result in a large amount of savings.

2. Objectives

The objectives of this project were:

- To effectively collect environmental, traffic and loading data from the test site.
- To determine the effect of the environment and traffic on pavement response for the pavement section.
- To design the optimum pavement for the site based on traffic, temperature and materials properties data.

3. Background

It is important to understand how a pavement responds to traffic and environmental conditions when designing a pavement structure. Currently road design standards are based off of testing done in Illinois in the 1960's through the AASHTO specifications. However useful these standards are, they might not be valid to all roads around the United States. Data from a test site along Route 15 in Guilford, Maine will provide the information needed to design a typical pavement section in that region of

Maine. This specific road segment was chosen as a test site due to its typical pavement design and traffic loading experienced around Maine. Currently the instrumentation at the test site consists of: thermocouples, moisture gauges, resistivity gauges, HMA strain gauges, subbase and subgrade pressure cells, and strain gauges. All the instrumentation was installed during pavement reconstruction. The pavement cross section is a soil subgrade covered with "new" subgrade made of old HMA, HMA base, HMA binder and lastly a HMA surface layer. A Weigh in Motion (WIM) detector was recently installed to record traffic loading and vehicle classification.

4. Literature Review

4.A. Literature Review Summary:

There is a general trend in the pavement design industry to gather more site specific data. The traditional method was to use load equivalency factors. These methods for predicting pavement damage have been found inadequate[1]. Current research shows that pavement design needs to reflect site specific conditions[2]. The factors that influence pavement deterioration include tire pressure[3], temperature and traffic [4]. Efforts have been made to study the methods used to gather the site specific data[5,6,7,8,9,10] and tire pressure[11]. More complex models have been developed to analyze the tire-pavement interface[12].

One of the major factors influencing pavement deterioration is traffic. Specifically, the majority of the studies showed that vehicle speed[13,14,15], loading position[16,17,18] and magnitude of loading[19], all have a significant effect on pavement response[20]. Speed has been found to greatly affect horizontal transverse strain under the HMA but it did not affect the vertical effective stress in the same position[21]. In addition, as vehicle speed increased, the magnitude of the calculated pavement strain response decreased[22]. Pavement breakdown, especially at the pavement edges, is most affected by the lateral position of the tire[23]. This is due to the fact that when there are both longitudinal and transverse strains at the pavement surface, tensile strains result at the edge or adjacent to the contact area and compressive strains result within the contact area[24]. The weight of the vehicles can result in two common pavement failures, fatigue, too much tensile strain, and rutting, too much compressive strain[25].

Some studies show that tire pressure, under normal ranges, have been found not to affect the measured vertical compressive stress and the measured horizontal transverse strain at the bottom of the HMA layer[26,27]. However, there are some others that find this to be false. They have found that Pavement strain is directly related to tire pressure and tire area, specifically the strain resulting right below the tire[28] and thus do need to be considered when designing a pavement, especially when designing a pavement with a thin HMA surface layer[29,30,31,32,33]. The results of one study found that at the same load level and asphalt thickness, a higher tire pressure is associated with a larger critical transverse tensile strain[34]. Another study found that a tire "loaded at the rated load and inflation pressure may produce maximum stresses, and hence the calculated analytical parameters at the tire center position near the bottom of the thin surfacing." However, for an under inflated or over inflated tire "two maxima located within the asphalt layer under the maximum applied stress position, which means at the tire edges" may result[35]. A possible reason for the polar discoveries is due to the how the tire pressures were analyzed. Conventional theory has been that tire-pressure is applied over a uniform circular area. However, this assumption has been overruled by some studies[36,37] and one study even found that response due to non-uniform contact tire-pavement stress distributions is in the range of 6–30% higher than when uniform pressure is assumed[38].

Another factor that greatly affects pavement performance and response is due to environmental conditions[39]. Except for one report of otherwise[40], the majority of research has found that induced pavement stresses are most influenced by temperature variation, specifically in the asphalt concrete layer. Same is also true due to sublayer moisture content that creates stresses, typically during the spring-thaw season[41,42,43]. Temperature variation can affect pavement response in two ways, daily or seasonally. It was determined that the most variability in daily temperature of the pavement was observed in the layers closer to the surface. Surface pavement temperature variations during the daily and yearly cycles were influenced by the solar radiation, air temperature, wind speed, and to some extent the temperature of the ground[44]. It was found that strain readings were higher in the binder layer during September than February. Similarly, it was discovered in the middle of the subbase layer that tensile strains were higher in September than in July[45]. In addition, "spring-thaw weakening contribute to loss of load bearing capacity and subsequent pavement failure." The defrosting process is delayed in the deeper layers when compared to the upper layers[46]. Lastly, through use of the subgrade moisture content sensors, it was found that moisture content is constant until October; at that point significant changes occurred. However, it was found that "these changes did not seem to have significant effects on the subgrade shear wave velocity."[47]

The literature review was conducted to identify recent studies about instrumented pavement, the instruments used, and the data being collected. The literature search was conducted by searching relevant electronic databases and scholarly works online. The following reviews contain a brief description of the project conducted, the objectives of the project, and what was done to achieve those objectives. In addition, any conclusive points that were made in the articles were provided.

4.1. Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW) By: Shelley M. Stoffels, Mansour Solaimanian, Dennis Morian and Hao Yin.[48]

The Pennsylvania Department of Transportation (PENNDOT) has sponsored a project to provide data to validate and calibrate its regional Superpave design. Under the project name, Superpave In-Situ Stress/Strain Investigation (SISSI), they hope to create a new Mechanistic-Empirical Pavement Design Guide (MEPDG) using instrumentation and analysis of eight Superpave pavement sections in northern and southern Pennsylvania. The sections are half newly constructed overlays and half existing pavements that have been designed with currently used materials and practices and are open to normal traffic. The project included detailed "monitoring of the construction process, and an intensive materials characterization effort, detailed load-response information, traffic and environmental data, and performance measures."

The paper, *Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)* by Shelley M. Stoffels et al., describes the results of dynamic gauge response (due to loading), WIM analysis for traffic data analysis, as well as subsurface environmental gauges to analyze "variation in pavement temperature with respect to time and season, depth of freezing temperature, and variation of temperature with depth."

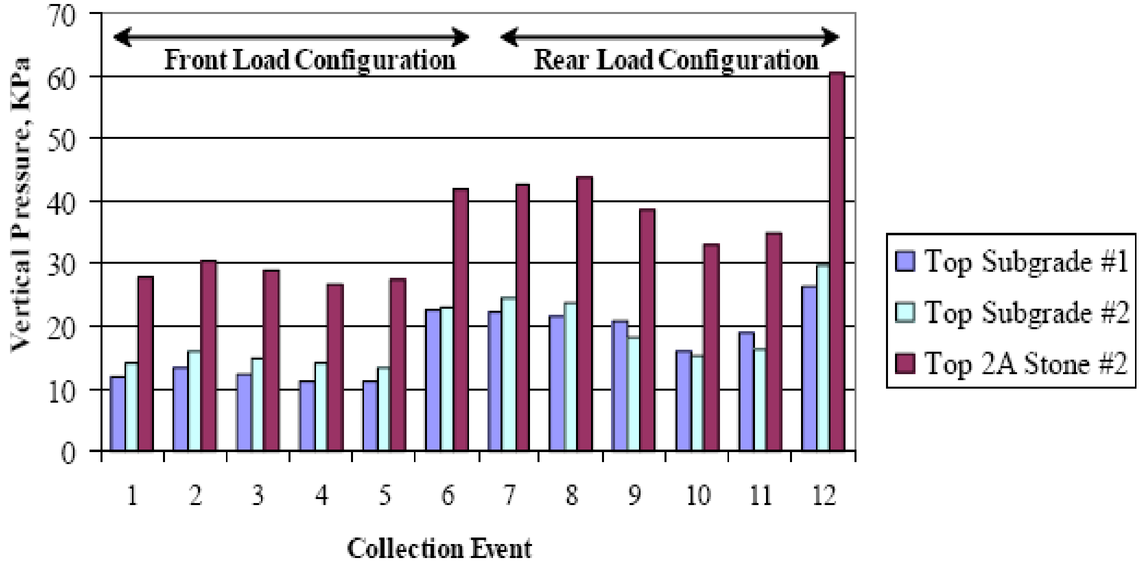


Figure 4-1 Comparison of pressure cell responses in subgrade and subbase (5/4/04).49

Several important conclusions relating to pavement response and design resulted from the project. First, it was confirmed that pavement response is affected by the speed of the traveling vehicle as well as the position of the tire with respect to the location of the gage. It was determined that "the larger the lateral deviation of the loading point form the gage position, the less will be the magnitude of the gage response." Second, analysis of the vertical pressures in unbound layers of the pavement using pressure cells showed that there is higher pressure in the subbase than those in the subgrade (both cell are positioned at the top of each layer). Figure 4-1, shows the results for the test section at a central PA site.

Third, strain values decreased along the depth of the pavement structure. Fourth, there is a significant difference in how a pavement responds during varying seasons. It was found that strain readings were higher in the binder layer during September than February. Similarly, it was discovered in the middle of the subbase layer that tensile strains were higher in September than in July. Fifth, the data collected with the weigh-in-motion stations (WIM) were found to be accurate because they "compare well with the actual weights and attempted speeds."

Lastly, there were significant conclusions relating to the environmental data collected. It was determined that the most variability in daily temperature of the pavement was observed in the layers closer to the surface. Surface pavement temperature variations during the daily and yearly cycles were influenced by the solar radiation, air temperature, wind speed, and to some extent the temperature of the ground. By analyzing results seasonally it as found for colder regions that the "freeze-thaw cycling and spring-thaw weakening contribute to loss of load bearing capacity and subsequent pavement failure." The defrosting process is delayed in the deeper layers when compared to the upper layers.

4.2. Design and Instrumentation of the Structural Pavement Experiment at the NCAT Test Track

By: David H. Timm, Angela L. Priest and Thomas V. McEwen.[49]

Due to the limited nature of empirically-based design, there has begun a shift toward mechanistic-empirically (M-E) based procedures in the pavement design industry. There is much that still needs to be investigated because of the variety of material types, material properties and climatic conditions throughout the country. Because of the aforementioned reasons a structural experiment was conducted at the National Center for Asphalt Technology (NCAT) test track to advance M-E design and analysis. In the paper, *Design and Instrumentation of the Structural Pavement Experiment at the NCAT Test Track* by David H. Timm et al., the objectives, and scope of the project were outlined. The main objective of this paper was to describe the instrumentation chosen, the sensor installation procedure and data acquisition system installed.

The objectives of the project are outlined as follows: first, to validate mechanistic pavement models; second, to develop transfer functions for typical asphalt mixtures and pavement cross-sections; third, to study dynamic effects on pavement deterioration from a mechanistic viewpoint; and fourth, to evaluate the effect of thickness and polymer modification of asphalt binders on structural performance. The test track was made up of eight pavement sections of varying thickness and material composition and in-situ instrumentation to measure "asphalt strain, compressive stresses in the unbound layers, moisture, and temperature" The pavements were designed according to the 1993 American Association of State Highway and Transportation Officials (AASHTO) Design Guide methodology and consisted "primarily of three HMA thicknesses and modified versus unmodified binders" as well as two sections with "an SMA surface course and a rich bottom layer". The instrumentation was installed to provide the following pavement responses: asphalt horizontal strain, base and subgrade vertical stress, subgrade moisture and vertical temperature profiles. The data collection was conducted through slow speed acquisition (hourly averages) as well as high-speed dynamic acquisition (5 kHz). Lastly, deflection testing and surface condition surveys were done.

The main conclusion that resulted from this portion of the project were relating to the installation of the sensors. Prior to the first array of strain gauge installation, "#8 granular base material was placed to a depth of 1 in. in each of the 3 inch deep cable trenches." Then the gauges were placed in their approximate location and the cables were laid in the trenches. Lastly, "the trenches were then filled with the same sieved material and compacted using a Marshall hammer to restore the grade". During the gauges placement, several "did not have a cable tie anchoring the cable to axial bar or it was removed to facilitate placement of the cable in the trench." After paving, it was found that half or six of the twelve gauges were of poor serviceability. Unfortunately it was impossible to know whether not using the cable ties "to attach the cable to the axial bar and transverse flange of each instrument in an attempt to provide strain relief to the connection" would have increased serviceability. However, in later gauge arrays this procedure was followed and the asphalt strain gauge's serviceability in the other test section improved greatly. Therefore, the major conclusion found by the authors was that in future asphalt strain gauge installations that additional cable ties should be used to increase the survivability rate.

4.3. Dynamic Pavement Response Data Collection and Processing at the NCAT Test Track
By: David Timm and Angela Priest[50]

The project reported in this paper was set up to measure the pavement responses under dynamic truck loads. This report specifically talks about the collection and methods of processing of the stress data.

The NCAT test section is located in Auburn, Alabama. The test track has eight sections labeled N1 through N8. Between the eight test sections, there are over 133 gauges. Each section was trafficked three times by the same truck under similar conditions. The information was collected by a DATAQ data acquisition system. The data was collected at two thousand samples a second.

A DADiSP system was used to compile the information from the DATAQ acquisition system. A moving average was used in the DADiSP program to clean up the electronic noise from the raw data and to provide an average from the large amounts of data collected. The current procedure for analyzing the data involves visually selecting the baseline and local maximum and minimum points of the signal with the cursor in DADiSP and copying them into an Excel workbook. The voltage and time of the selected point are recorded and organized by date, section, gauge, truck pass, and axle. This method of processing is very tedious and requires a lot of time. Currently an automated algorithm is being developed to process the data much more quickly.

4.4. The Virginia Smart Road: The Impact of Pavement Instrumentation on Understanding Pavement Performance

By: Imad L. Al-Qadi[a], Amara Loulizi[b], Mostafa Elseifi[c], and Samer Lahouar[d][51]

This paper presents the description, calibration procedures, installation, and performance of the instrumentation used at the Virginia Smart Road to measure flexible pavement response to loading. Also presented are the measured horizontal transverse and longitudinal strains induced in the hot-mix asphalt (HMA) during compaction with a steel drum compactor both with and without vibrations. In addition, this paper presents the data collected and used to determine the vertical compressive stress pulse induced by a moving truck at different locations beneath the pavement surface. These data were also used to determine the effects of temperature, speed, and tire inflation pressure on the measured vertical compressive stress and measured horizontal transverse strain, induced by a steering-axle tire of 25.8kN, under the HMA layer.

The data were used to make a comparison between measured pavement responses to truck loading with those calculated using linear elastic theory. It was found that HMA is subjected to very high horizontal strains during compaction— especially when vibration is used. It was also found that a haversine equation well represents the measured normalized vertical compressive stress pulse for a moving vehicle. Haversine duration times varied from 0.02s for a vehicle speed of 70km/h at a depth of 40mm to

1.0s for a vehicle speed of 10km/h at a depth of 597mm. As expected, temperature was found to significantly affect the measured vertical compressive stress and measured horizontal transverse strain under the HMA layer.

Although speed was found not to affect the magnitude of the measured vertical compressive stress, it was found to affect the loading time. On the other hand, speed was found to significantly affect the measured horizontal transverse strain under the HMA layer.

Variation in tire inflation pressure from 552kPa to 724kPa was found not to affect the measured vertical compressive stress and the measured horizontal transverse strain at the bottom of the HMA layer. A comparison between the measured responses and those calculated using a finite element model that uses linear elastic theory indicated that the elastic theory overestimates pavement responses at low temperatures but significantly underestimates these responses at high temperatures. An improved prediction of pavement responses was achieved by modifying the bonding conditions at the interfaces, and by modeling HMA as a viscoelastic material.

4.5. Minnesota Road Research Project: Load Response Instrumentation Installation and Testing Procedures

By: Harris B. Baker, Michael R. Buth, David A Van Duesen[52]

The Minnesota Road Research Project (MN/Road) began a study in 1994 to determine the effects of two different types of loading: freeway traffic and calibrated trucks. The testing was done at a cold region pavement facility built in Minnesota, with the mainline of the facility part of I-94. The facility contains 40 500 foot test sections of pavement with sensors. The goal of the facility is to be able to improve upon existing pavement models as well as creating new models which can be applied to roadways. The facility also allows for research on how pavement responds and performs under very specific conditions. The results of the response research are important to create accurate mechanistic-empirical response models.

This report includes detailed listings of all the sensors and other equipment used to obtain the results. It was determined in the study that a key component of accurate data acquisition is to have the system in working order before sensors are installed in the pavement due to both the short life of sensors and the necessity to have readings taken during all phases of the pavement life. The sensors must also be placed in a manner which will not cause problems during installation. In the case of this study it was found that some sensors were planned too close together and therefore presented troubles to each other when the time came to install. The handling of the instruments also proved to be a source of inaccurate readings. Although much of the damage to equipment can be credited to the harsh environments that they are objected to, it is also possible that they are damaged during the moving and installation process. The report states that everyone involved in a project must be well educated on the goals of the project for everyone to respect the equipment at hand and use the most care when handling it.

The MN/Road report also includes the actual installation procedures that are used in the tests. To measure the dynamic horizontal strains in the asphalt pavement all gauges are installed at asphalt/concrete base or sub grade immediately prior to paving. The project also tested for the strains in concrete pavements. Other tests included vertical deflection in both asphalt and concrete, static horizontal movement, acceleration in rigid pavements, dynamic vertical pressure and dynamic strain in steel dowels. Tests were also performed on the sensors to determine if the installation process as well as the loads on the pavement had not altered the validity of the data produced in the tests. Several said tests are described in the report. Tests conducted on the sensors included circuitry and wire checks as well as integrity and response tests.

4.6. Pavement Evaluation and Development of Seasonal and Temperature Adjustment Models Using Seismic Pavement Analyzer (SPA) By: Nenad Gucunski, Sameh Zaghloul, Rambod Hadidi, Ali Maher and Tony Chmiel[53]

The New Jersey Department of Transportation (NJDOT) has begun a study to determine the seasonal and temperature corrections and adjustment models needed for the AASHTO design guide for their state through the use of geophysical methods, specifically seismic techniques. Throughout New Jersey there are twenty four instrumented pavement sections, twenty one flexible section, two rigid sections, and one composite pavements section. Each section were separated into three different classes depending on the objective of the section and thus instrumented to suit the objectives needs. The sensors recorded pavement temperature, frost-thaw, moisture, ground water table and environmental changes (including air temperature and rainfall). In addition, pavement response was collected through field observation using Falling Weight Deflectometer (FWD) and Seismic Pavement Analyzer (SPA) during a two year period. Field observations were taken monthly (or by-monthly during freeze-thaw periods) where as the in pavement sensors were continuously collected and saved for future analysis. So far only 16 testing cycles, or FWD and SPA rounds, have been performed but their hope is to use this information to determine the variation of the elastic modulus in flexible pavements over time.

One of the seismic techniques begin used to evaluate pavement response is the Spectral Analysis of Surface Waves (SASW). SASW has been used to create pavement shear wave velocity profiles to determine that during the warm period from June to August, low asphalt concrete (AC) velocities were measured due to a decrease in AC modulus during the hotter weather months. They authors determined a preliminary model for the "strong relation between pavement temperature and shear wave velocity" however more data is needed to get a more accurate and reliable model.

The subsurface temperature sensors revealed very high temperature gradient in the pavement. For example, during September there was a 20°F temperature difference between the top and bottom of the paving layer. Also, a subsurface temperature measurement about 25in below the surface was as much as 80°F or as little as 40°F depending on the time of year. Temperature variation can have an extreme effect on pavement response so it is very important to know the expected variation for where a pavement is being designed for.

Lastly, through use of the subgrade moisture content sensors, it was found that moisture content is constant until October; at that point significant changes occurred. However, it was found that "these changes did not seem to have significant effects on the subgrade shear wave velocity."

As more data analysis and collection proceeds it is the hope of this project to first put their data to the test of currently available models and then to create models that are better calibrated to the conditions of New Jersey for practically pavement design.

4.7. Load Testing of Instrumented Pavement Sections
By: University of Minnesota, Department of Civil Engineering[54]

This paper serves as a literature review to determine if the load equivalency factors used by in AASHTO pavement design are still valid as well as summarizing current definitions, procedures and commonly accepted facts about pavement response and performance.

When determining what is a “great” pavement design the most factors that affect pavement response are: total loading, axle spacing, tire location, and tire pressure. “Pavement responses are indicators of the load related distresses which ultimately dictate the failure of the structure.” Pavement design in general is done using AASHTO’s procedure which is an empirical method. This method converts axels of different configurations and weights to “80kN (18-dip) equivalent single axle loads on the basis of equal performance.” This is a simplistic method that also averages seasonal changes in subgrade and base layers and mostly ignores surface layer properties. With the many agencies moving toward mechanistic-empirical approaches, which are less limiting in their applications, many aspects of design are being reanalyzed to better take into account regional differences, including traffic loading and environmental variances.

There are currently several different models to evaluate the effect of differing load types and environmental conditions. It has been found through research that by evaluating load, vehicle, pavement characteristics and environmental conditions with pavement responses including pavement stresses, strains, deflections, and pavement distresses, for a particular field obtained response measurements, usually creates models for pavement response and thus design.

When analyzing the pavement response there are several direct relationships that have been found to be true. First, fatigue is mostly related to the magnitude of axel loading. Second, rutting is influenced most by the vehicle’s gross weight and the asphalt concrete material properties. Third, accelerated pavement damage is related to the lateral position of traffic on the road. For example, there is a greater damage near the edges of the pavement. Forth, pavement strain is directly related to tire pressure and tire area, specifically the strain resulting right below the tire. Lastly, induced pavement stresses are most influenced by temperature variation, specifically in the asphalt concrete layer. Same is also true due to sublayer moisture content that creates stresses, "especially during the spring-thaw season."

In closing, the paper determined that predicting pavement damage is controlled by many more factors than the AASHTO LEFs model can accurately depict. Thus, there is a great need for the re-evaluation of the AASHTO load equivalency factors.

4.8. Using Fiber-Optic Sensor Technology To Measure Strains Under The Asphalt Layer of A Flexible Pavement Structure[55]

By: Stephen R. Sharp, Ph.D., Khaled A. Galal, Ph.D., Mohamed K. Elfino, Ph.D., P.E.

This paper reports a study of a flexible pavement system instrumented using fiver-optic strain sensors (FOSS). This study was conducted to exhibit the feasibility of using FOSS to monitor the long-term strains in flexible pavements subjected to repeated traffic loads. These strains were compared the strains calculated using a multi-layer elastic (MLE) analysis.

The MLE analysis was conducted both before and after the installation of the FOSS. It was done to monitor strains during and after construction. Strains caused by the construction traffic were collected by the FOSS during construction operations and compared to results of the MLE analysis. Additionally, after construction, dump truck and falling weight deflectometer (FWD) strains were collected at multiple load levels and compared to the MLE analysis.

It was found that the in-situ strains during construction were at least 50 times that which were calculated using the MLE analysis. It was also found that the FOSS was able to collect stain data even during the very hot temperatures that the construction activities presented. Additionaly, the field data mimicked very closely the measured deflection under dump truck and FWD loading.

This study concluded that the MLE analysis “can be used to validate and calculate the strains in asphalt pavement sections.”

4.9. Guide for Mechanistic-Empirical Design[56]

This report presents a guide to pavement design using mechanistic-empirical principles with numerical calibrated models from the Long-term Pavement Performance program. This study started in the mid-1990s and is wrapping up. This guide is slated to replace previous AASHTO pavement design guides. It stresses the availability of local data to improve pavement design. Some of the more critical local data include environmental and traffic data.

“Environmental conditions have a significant effect on the performance of both flexible and rigid pavements.” Some of the factors that play a key role in defining the limits the environment can have on a pavement performance include: the amount of precipitation, temperature, freeze-thaw cycles, and depth to the water table.

Temperature has a significant effect on the modulus of Asphalt bound materials. “Modulus values can vary from 2 to 3 million psi or more during cold winter months to 100,000 psi or less during hot summer months.” However, unbound materials are only affected by temperature if ice forms. The water in soil freezes below 32°F and raises the resilient modulus to values 20 to 120 times higher.

“Traffic data is one of the key data elements required for the structural design/analysis of pavement structures.” Traffic data is used for estimating the loads applied to the pavement and the frequency the loads are applied.

4.10. In-Situ Measurements of Flexible Pavement’s Response to Vehicular Loading
By: Salman A. Bhutta1, Imad L. Al-Qadi2, and Thomas L. Brandon[57]

This report discusses the experimentation using geosynthetics in pavement design in Bedfor County, VA. The purpose of the report is to validate the results of a similar test conducted at Virginia Tech in 1992. This previous testing used dynamic loadings in a controlled laboratory setting to test the performance of geogrid and geotextile materials in pavement. The 1992 report found that the geosynthetics improves the performance of flexible pavement because the synthetics provide separation between the aggregate layer and the sub grade layer. The most recent experiment used a test section to validate these results under non laboratory conditions. This pavement test section was installed in a newly laid sub grade.

The instrumentation installed had the main purpose of collect data on stresses, strains, temperatures, and moisture at critical points in the pavement test section. These critical locations were to be located at the bottom of the hot mix asphalt, the top of the base layer and the top of the sub grade. These locations are considered critical because the reactions at these locations play a large role in fatigue and rutting. The various instruments used included pressure cells, strain gages, thermocouples and moisture sensors. Within the first three months of testing most of the strain gages failed. This led to the conclusion that recording geosynthetics was difficult due to the medium that the strain gages were attached to. It was determined that geogrids develop far less strain than geotextiles due to geogrid being a stiffer material.

The findings of this experiment verified with those of the previous laboratory testing in relation to dynamic response of ordinary vehicles. Geosynthetics may improve the pavement due to the movement of materials at the base course and subgrade interface. Geosynthetics can stabilize these sections.

4.11. Impact of Changing Traffic Characteristics and Environmental Conditions on Flexible Pavements

By: Zhanmin Zhang, Joseph P. Leidy, Izydor Kawa,W. Ronald Hudson[58]

This report begins by making the very important statement that although pavement design is shifting steadily towards using an mechanistic, in Texas, where the study was conducted, pavement is designed using AASHTO data. It is important to know that AASHTO recommendations come from data that is not collected in an environment that is overly comparable to Texas. Texas has also seen an increase on the number of trucks that run through the state, in part being located between the Midwest and Mexico. The report shows the methods to compare the results of AASHTO to the results that would apply specifically to Texas roads.

The report states that AASHTO findings, concerning tire pressure and appropriate response, are often inconsistent and contradicting. The AASHTO LEF's were developed using four parameters; axle load, configuration, structural number for flexible pavements and slab thickness for rigid pavements, terminal serviceability level. The report established parameters that are specific and important to Texas. These include higher tire pressures, newly developed tire widths, new axle configurations, and unique environmental factors.

The key finding of this report was the use of a fatigue model to link the data from a computerized mechanistic design program and AASHTO design standards. From this relationship the report was able to make conclusions about tire pressure, the new tire widths, axles and environmental factors. It found that a higher tire pressure on dual tire vehicles and supersingle axle vehicles is significantly more damaging to the pavement than if calculating using AASHTO standards. For tandem and tridem axles the results were approximately the same. It was determined that the environmental conditions do not have a large effect. It is said in conclusion that these results are ultimately based on AASHTO testing results and should not be applied to pavements which are not designed in such a manner.

4.12. Validation of Flexible Pavement Structural Response Models Using Mn/ROAD Data
By: Angel Mateos, Mark B. Snyder[59]

This report utilized data from the Minnesota Road Research Facility to draw conclusions concerning three main objectives. The objectives are the characterization of the structural behavior of flexible pavements, determine the influence of axle load, configuration, speed, and tire on pavement response, and lastly to validate a flexible pavement structural model and an appropriate means of determining input parameters.

The MN Road facility features 40 test cells. The facility has testing sites along Interstate-94 which is used to analyze highway pavement response as well as a closed loop which is used to simulate loads of rural roads. Dynamic horizontal strain was taken from the bottom of the asphalt layer. It is noted in the report that of the original gages put in place to record this data, only a few of the test cells had working gages to record the data. The study utilized four separate sections. Because of this all the data needed was obtained, although all not in one cell.

The study concluded that the pavement response to varying loads was linear and that varying tire pressures did not effect the pavement. It was also found that an increase in vehicular speed resulted in a decrease in strain measurements. Ultimately it was found that the use of linear elastic models to develop pavement can be effective, but may also come with certain negatives. There are some aspects of the design, such as asymmetry in longitudinal response that cannot always be found. The study validated the prior research, but found ways in which further studies could be impeded.

4.13. Analytical Study of Effects of Truck Tire Pressure on Pavements Using Measured Tire-Pavement Contact Stress Data

By: Randy B. Machemehl, Feng Wang, and Jorge A. Prozzi[60]

This report investigates the results of inputting tire-pavement contact stress data into an elastic model multilayer pavement design program. The study inputted the data in both a thin and a thick pavement. The purpose was to see if there is a difference in the two methods most commonly used to obtain the data, conventional and major pavement responses at certain test locations. Conventional assume that tire pressure is distributed uniformly over a circular area and is equal to the tire inflation pressure. This report looks at testing which does not assume tire pressure is uniform across a testing area.

A two way model was used to compare the pavement response and track the effects of truck tire pressure on the pavement. This statistical analysis found that tensile strains were most prominent in the bottom of the pavement structure while eon the surface tensile stresses were prevalent. From this it was found that varying tire pressure only has a significant effect on think pavements.

In conclusion however, the report did not focus on the actual statistical findings, but the fact that using measured tire pavement contact stress data a pavement analysis can be improved significantly. It was determined that using the conventional method usually will underestimate pavement responses at low tire pressures and overestimate at high tire pressures. This study also found that because tires can deflect freely in the longitudinal direction that the impact area may be more rectangular and circular, further reducing the validity of the conventional method. In general though, the effects on the pavement due to varying tire pressures are much lower than the effects of loads on the same test area.

4.14. Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses By: Feng Wang and Randy B. Machemehl[61]

This project was conducted in Texas at the University of Texas in Austin. The tire-pavement contact pressure data was provided my TxDOT. The data came from a test site in South Africa using a Heavy Load Simulator and a Stress-In-Motion transducer pad. The most widely used tire in Texas, the Goodyear 11R24.5, was chosen to be used in the experiment. The tire-pavement vertical stress loads were measured at tire loads 20, 24, and 31 kN and at a tire inflation pressures of 483, 690, and, 896 kPa.

This project concerned the creation of a quick way to predict critical pavement responses to tire loading conditions and pavement structures. The project was started due to the assumption that the contact tire pressure was uniform and circular. Due to recent studies, however, this is not the case. This study used measured non-uniform tire-pavement contact stress data from different tire loading and inflation pressure were inputted into a program called ANSYS to compute immediate pavement responses. Finite element models for single tire, dual tire, and tandem axles of dual tires were created from the program. Running these finite element models for a factorial experiment design of different tire loads, tire pressures, pavement structures, and tire configurations, generated pavement response data. Using regression models that relate critical pavement responses to tire loading conditions and pavement structures, a quick method of predicting critical pavement responses was developed.

4.15. Mechanistic-Empirical Study of Effects of Truck Tire Pressure on Pavement Using Measured Tire-Pavement Contact Stress Data[62]

By: Feng Wang and Randy B. Machemehl

This study reviews the truck tire inflation pressure and its role in tire-pavement interaction. Pavement studies traditionally approximate tire-pavement contact stress to be uniformly distributed over a contact area assumed to be circular and equal to the tire pressure. Recent research has shown this is not true. This study measured the tire-pavement contact stress and used a finite element program to determine the immediate responses from three different tire configurations. The tire configurations evaluated included the single tire, duel tires, and dual tire tandem axles.

The computed pavement responses were further analyzed using pavement distress transfer functions to determine the effects of tire inflation on the pavement performance. Both thin and thick asphalt concrete pavement structures were examined. Pavement responses calculated by the finite elements method were compared with those predicted by a multilayer program using traditional uniform contact stress.

The computed results showed that the traditional uniform contact stress method and multilayer program tend to overestimate the horizontal tensile strains at the bottom of the asphalt concrete. However, the vertical compressive strains at the top of the subgrade tend to be underestimated. Results also show that the overestimation and underestimation tends to intensify with increased tire pressure. These estimations also are more significant for thin pavements than for thick pavements and for dual tires and tandem axles than for smaller vehicles. This study also found that the "prediction of effects of tire pressure on pavement performance shows that increases in tire pressure result in increased pavement distress due to both cracking and rutting, and tire inflation pressure is also related to the shape of pavement ruts."

4.16. Effect of measured 3-D Tire-Pavement Contact Stress on Pavement Response at Asphalt Surface[63]
By : Rong Luo, and Jorge A. Prozzi

This paper investigated fatigue cracking, specifically top-down cracking that results from the horizontal strains at the pavement surface due to high wheel loads. To analyze this effect of actual 3D contact stress on pavement response, "this study evaluates the horizontal strains at the surface of the asphalt layer produced by measured 3-D non-uniform stresses." However, in should be understood that current research has found that it is not correct to assume that the tire-pavement contact stress was equal to the tire inflation pressure and to be uniformly distributed over a circular contact area when calculating horizontal strains at the pavement surface. Instead, "the tire-pavement contact stress is non-uniformly distributed in a noncircular area" and thus "the actual contact stress varies along the longitudinal (vehicle travel direction) and transverse directions (perpendicular to the longitudinal direction)".

The study evaluated 5 wheel loads, 5 tire inflation pressure levels, and 12 pavement structures with different asphalt thicknesses using a multilayer linear-elastic computer program, CIRCLY. This program was able to estimate "horizontal strains in the longitudinal and transverse directions under each combination of load, tire pressure and asphalt thickness.” CIRCLY had the unique ability was to both be able to handle normal as well as shear stresses at the pavement surface. This program was ideal because it used less data and was less computationally demanding when compared to finite element models. In addition, “horizontal strain distributions and critical (maximum) horizontal strains due to uniform stress were also calculated for comparison due to non-uniform stress” were performed.

This study was able to make a multitude of conclusions. First, when there are combined 3D stresses, both longitudinal and transverse strains at the pavement surface were tensile strains at the edge or adjacent to the contact area and were compressive strains within the contact area. Second, the vertical and transverse stresses showed significant effect on the longitudinal strains at the pavement surface. However, only vertical stress has significant result on the transverse strains at the pavement surface. Third, the “critical longitudinal tensile strains decrease initially with surface thickness and then increase. There appears to be an optimal value of asphalt thickness that corresponds to a minimum critical longitudinal tensile strain. The optimal asphalt thickness depends on the magnitude of the wheel load but is independent of tire pressure. The tire pressure is positively correlated with the critical longitudinal tensile strain.” Forth, the “critical transverse tensile strains decrease monotonically as the asphalt thickness increases for the lower load levels.” It was found that as the load levels rose, the critical transverse tensile strains increased initially and then decreased as the asphalt thickness increases when combined with a low tire pressure. In addition, “the critical transverse tensile strains decrease monotonically for a higher tire pressure.” It was future concluded that at the same load level and asphalt thickness, a higher tire pressure is associated with a larger critical transverse tensile strain. Lastly, the two regression models created to predict the critical tensile strains in both longitudinal and transverse directions were able to address the joint effect of asphalt thickness, tire load and tire pressure on the critical horizontal strains. The models were determined to both be applicable to the pavement structures evaluated as well as able to capture general trends.

4.17. Determination of Pneumatic Tire/Pavement Interface Contact Stresses Under Moving Loads and Some Effects on Pavements With Thin Asphalt Surfacing Layers

By: M. de Beer, C. Fisher, and Fritz J. Jooste[64]

In this paper the authors explain the system they developed for simultaneous measurement of tire/pavement interface contact stresses of slow-moving pneumatic truck types. As it can be seen Figure 4-2 below this is important to analyze because tire pressures are increasing but not much is known as how the pavement will respond to these added stresses or even how to design for them.

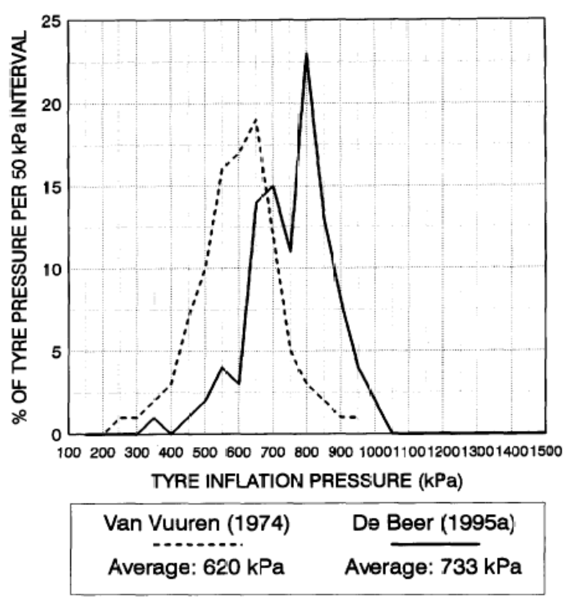


Figure 1a
Average measured tyre inflation pressure distributions of heavy vehicles (axle load > 7 000 kg) on roads in the province of Gauteng, South Africa

Figure 4-2 Tire Inflation Pressure Distribution Comparison for Two Time Periods

Even more specifically, South Africa often uses relatively thin pavement (<50mm) unfortunately very little has been researched as to how to successfully apply mechanistic pavement design techniques under their unique pavement design. This is due primarily to the fact that there is an inappropriate definition of the contact stress condition at the tire/pavement interface.

Their first goal of this paper to try to answer the fore mention design problems was by discussing the development, calibration and use of the Vehicle-Road Surface Pressure Transducer Array (VRSPTA). The VRSPTA helped to improve quantification of the vertical, transverse and longitudinal tire/pavement interface contact stresses. In other words, it was used to understand the pavement response of differing tire types and pressures. The VRSTA consists of an array of "triaxial strain gauged steel pins fixed to a steel base plate, together with additional non-instrumented supporting pins, fixed flush with the road surface." Their second goal of the paper was to discuss some of the analyses and basic implications of the test results. Included in this was to develop prediction equations for quantification of these stresses, based on tire inflation pressure and loads for seven different tire types.

Through their analysis several conclusions were made. First, using the VRSPTA, it was found that "most of the time the maximum vertical contact stresses are indeed higher than the tire inflation pressure." Surprisingly, even loading and tire pressures which were below rating the contact stresses can be found to be up to twice the tire inflation pressure. Second, also using the VRSPTA, an accurate estimation of the maximum expected tire/pavement contact stresses for a fixed load and inflation pressure can be determine by several predictive equations for 3D contact stresses. The following conclusions were through the use of finite element analysis. Third, when a thin asphalt surface layer (<50mm) is used the stain energy of distortion, bulk stresses, and octahedral shear stress in the pavement change as a function of the applied stress. However, it must made clear that this is only true under instantaneous loading. Forth, a tire "loaded at the rated load and inflation pressure may produce maximum stresses, and hence the calculated analytical parameters at the tire center position near the bottom of the thin surfacing." However, for an under inflated or over inflated tire "two maxima located within the asphalt layer under the maximum applied stress position, which means at the tire edges" may result.

4.18. Investigation of Tire Contact Stress Distributions on Pavement Response By: Raj V. Siddharthan, N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly[65]

In this study two types of tires and different contact stress distributions were used to analyze important pavement response parameters generated from the finite-layer analytical model, 3D-Moving Load Analysis. Their objective was to develop a database of a number of commonly used "pavement response parameters computed using a recently developed finite-layer mechanistic approach under a variety of tire-pavement contact stress distributions." Their hope is that the database can be used to "assess and compare pavement performance predictions for different loading conditions using appropriate 'pavement performance transfer functions' (or performance equations)".

Their initial step was to investigate past studies to see what their model needed to be able to do as well as how they could be integrated previously used models into their own model. It was revealed that: tire-pavement contact stress distribution is significantly affected by tire inflation pressure, tire type and tire load; tire-pavement contact stress distribution is noncircular, nonuniform, and has noticeable interface shear stress components; and the crucial pavement responses are tensile strain at the bottom of the Asphalt Concrete (AC) layer as well as compressive strain at the top of the subgrade.

In the end, the authors found that the finite-layer approach using response evaluation, which treats each layer as a continuum and uses the Fourier transform technique, worked ideally to handle complex surface loading, a variety of tire imprints, is “more computationally efficient than moving models based on the finite-element method” and “can accommodate rate-dependent material properties (viscoelastic)” that is seen in AC pavement use. They decided that in addition to the already stated pavement response parameters the maximum shear stresses and shear strains in the AC layer at 0.05m for the surface under the outer edge of the tire would be valuable to monitor and analyze.

Through this study, the following conclusions were reached. First, the finite-layer model used can handle any specified stress distribution (normal and shear) resulting from nonuniform and complex traffic loads at the tire-pavement interface. Second, vehicle speed had a significant effect on all pavement response parameters, which was consistent with other field tests including the Pennsylvania State University test track, the Mn/ROAD, and the WesTrack studies. In general, it found that the magnitude of the calculated pavement strain response decreased with increased vehicle speed. Third, the difference between the responses computed with the uniform (conventional assumption) and nonuniform contact tire-pavement stress distributions is in the range of 6–30%. The range is dependent on many factors, including the type of response and pavement structure (thin or thick) and tire type (dual or wide base). However, it should be noted that “expect in the case of tensile strain at the bottom of the AC layer for a dual tire configuration, the responses computed with the nonuniform stress distribution are lower, which indicates that the use of conventional contact stress distributions is conservative”. “However, since the differences are indeed significant, care should be taken when conventional assumptions are used to calculate pavement responses for use in transfer functions to predict pavement performance.” Forth, when analysis of contact shear stresses was conducted, in both longitudinal and transverse directions, it was found that they “did not significantly influence any of the pavement response parameters investigated.” Lastly, strains reduced as the “vehicle speed increased signifies the need to calibrate accelerated laboratory pavement tests carried out at lower vehicle speeds (5–20 km/h)”. Therefore this database generated can also be utilized to calibrate laboratory performance data for use in field cases.

5. Data Collection Methods and Instrumentation

The test strip in Guilford, ME has a large array of instrumentations in place. The road section was stripped down and all but the Weigh in Motion detector was installed during the construction of the pavement structure. The following sections outline what instrumentation was utilized for this investigation and how the data was collected.

5.1. Traffic Data Collection

Weigh in Motion Technical

Weigh-In-Motion (WIM) data collection equipment can either be set up as in pavement systems or utilize portable WIM pads. At the test site in Guilford, ME an in pavement piezo sensor system is currently in place, as seen in Figure 5-1. The cross section of the instrumentation is shown in Figure 5-2.

Figure 5-1 In-Place WIM Instrumentation in Guilford, ME

Figure 5-2 Cross Section of WIM

As indicated in the title of this instrumentation, the data which is output includes weight of individual vehicles, as well as speed and vehicle class. The act of "weighing in motion" refers to the process that the equipment uses to measure the dynamic tire forces of a moving vehicle and estimating the corresponding tire loads of the static vehicle. The total vehicle weight of a moving vehicle is determined by the force of gravity acting upon all connected elements of the vehicle.[66] The piezo sensor accomplishes this by creating an electrical charge whenever a vehicle passes over the sensors. From this the dynamic loads are calculated. The static load is estimated using the measured dynamic loads and calibration factors.[67]

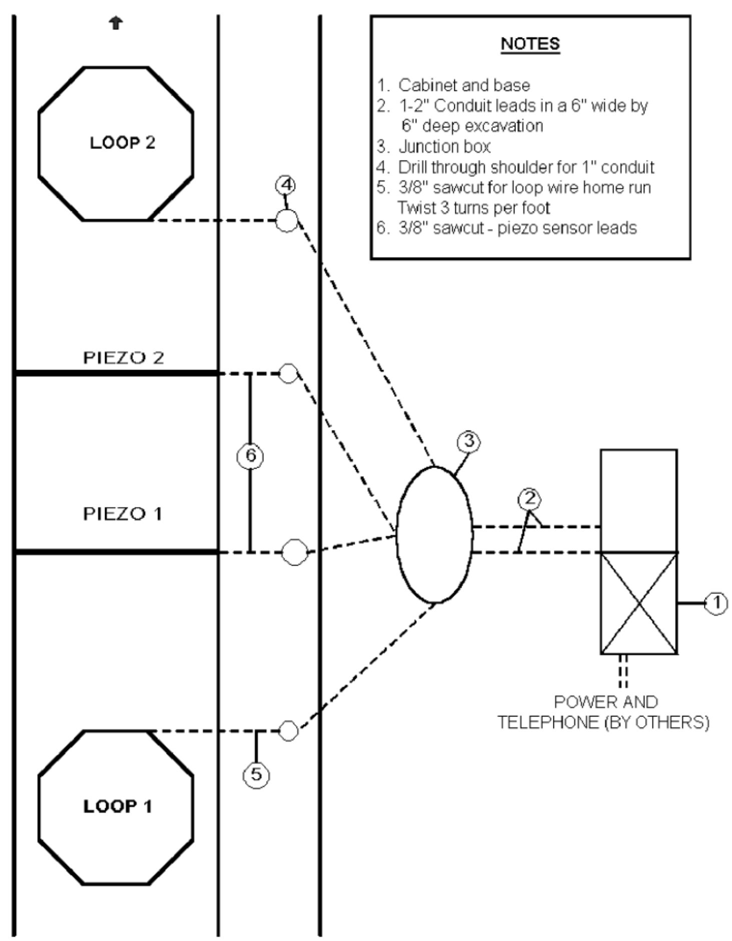


Figure 5-3: Example of Piezoelectric System Layout[68]

Data from the WIM is collected on a continuous daily basis and can be run through MIRA software in order to be analyzed. When analyzing the data questionable results can occur because of equipment malfunction. The site can simply record no data at all, which could be result of power failure or improper connections to the onsite computers. If the speed data has a large amount of data ranging from 0-5 MPH or 95-+ MPH it can be determined that either all the equipment or just a specific lane is having problems recording speed. A high percentage of invalid vehicle weights or overweight vehicles could possibly indicate malfunctioning equipment. And if Class 15 vehicles represent more than 5% of traffic in any given lane it could be assumed that there is a class data problem with the equipment.[69] Once the irrelevant data is sorted out, it is possible to use the data recorded by the WIM to make conclusions on vehicle types, classes and speeds, and ultimately use this data to determine loadings in the pavement and work towards designing a more desirable pavement for the test area.

WIM data is outputted using a program called MIRA. Once a report is run with the information required, it was transferred into Excel from a text file using Script by a Computer Science student here at WPI[70].

5.2. Gauges in Pavement

Environmental Data Collection

Thermocouple Gauges

The environmental data from the thermocouples was a key component in our analysis. At the test site, the pavement temperatures were measured using two strings of twelve Type T thermocouples as seen in Figure 5-4. The thermocouples were placed at the different levels. Due to failure, data from only 6 thermocouples were collect. This gave us 2 working thermocouples at each pavement layer.

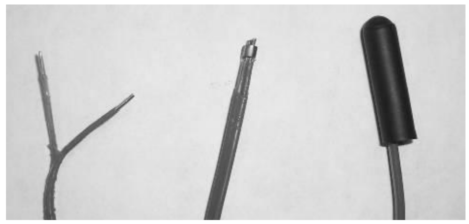


Figure 5-4 Thermocouple Device

The test site in Guilford contains two strings of twelve type T thermocouples at varying depths. The purpose of the gauges is to record temperatures in the sub grade, subbase and HMA layers. The thermocouples are made with twenty gauge copper constantan wire pairs. The reaction at the tip of the wire causes an electric potential that is proportional to the temperature difference between the end of the wire in the ground and the wire connected to the readout device.[71] Using the readout data the temperature of the ground can be calculated. The thermocouples were spaced along a wooden dowel and inserted into a previously drilled hole. The bottom five thermocouples were spaced .3 meters apart, the next 6 .15 meters apart and the final thermocouple of each string was placed on the top. The thermocouples were placed so that following final paving, the top of each string was located .4 to .5 meters below the final grade. [72]

Thermocouple Data Collection Methodology

The first step was to collect the data from the test site in Guilford, ME. The website Logmein was used to remotely log into the computer at the test site. Once in the computer, the program Loggernet was used to connect to the thermocouples and collect the data. There were originally complications when trying to connect to the thermocouples. The setup program for the thermocouples had to be downloaded and installed. Once the setup program was installed, each of the 4 Com Ports was tested and only 1, Com Port 4, had a successful connection. Once it was determined which port worked, Loggernet was recalibrated to import data from Com Port 4 and the data was finally connected.

After the data was collected, the next step was putting it into a usable format. The data that was collect was in a basic text file. It was imported into Microsoft Excel and put into columns and rows. With the data in Excel and in proper formatting and labeled, the analysis could start.

With the data sorted out and organized, it was used for numerous comparisons. Since data was collect for the three different layers, the differences in temperature were very important. The differences in temperature between each layer were plotted out and displayed per month of data collected. The data was further broken down and graphs representing the changes in the temperature per hour for each week were shown graphically. Each layer has its own graph showing the different temperature changes. These graphs and analysis's can be found in the results section for environmental data.

5.3. Stress/Strain Data Collection

Soil Pressure Cells

To measure the vertical stresses in the soil there are four soil pressure cells installed in the sub grade and sub base soils of the test site. These gauges are Dynatest Soil Pressure Transducers, type FTC 1 as shown in Figure 5-5. The bodies of the cells are constructed with titanium to help prevent wear due to environmental conditions and normal use. The pressure cell is covered in epoxy and sand and they contain a hydraulic design in order to improve linearity and sensitivity. The cell has a constant volume, so the gauge is sensitive to pressure over the entire area. The internal transducer of the cell has a full strain gauge bridge. The cells are capable of recording pressures from 10 to 200 kPa. [73] The cells are connected to the data acquisition equipment through buried wires.

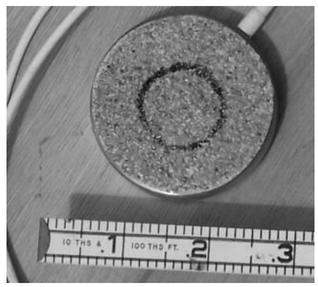


Figure 5-5 Soil Pressure Cell

Soil Strain Gauges

Soil Strain and Deformation Transducers (SSDT) type FTC-1 are used as the soil strain gauges at the test site. These gages can measure both permanent and dynamic strains with occur in the soil. The gages are made of stainless steel as can be seen in Figure 5-6. Four gauges are connected to their own signal conditional which they were calibrated to prior to installation in the soil. The gages were placed in holes filled with a stiff mortar mix which would keep the gauges in place during compaction. The soil around the gauges was hand compacted until the soil would prevent movement during paving so that the gauge could properly read traffic loadings. [74]

Figure 5-6 Soil Strain Gauge

Strain Data Collection Method

The strain data was acquired by remotely accessing the computer at the Guilford site which was receiving the data from the instrumentation. In all there are 12 sensors in place, resulting in 12 different readings for each vehicle that is recording. The strain gages are triggered by the WIM sensors. Since the WIM sensors are set to record traffic only over class 4 the strain data only represents vehicles over this class. The data output, in addition to the strain from the gages indicates at what time of day the corresponding lines are read. The traffic monitoring program saves files for every vehicle, or event, that passes over the gages. This data can be taken and graphed to determine how strains vary over time with a vehicle passing.

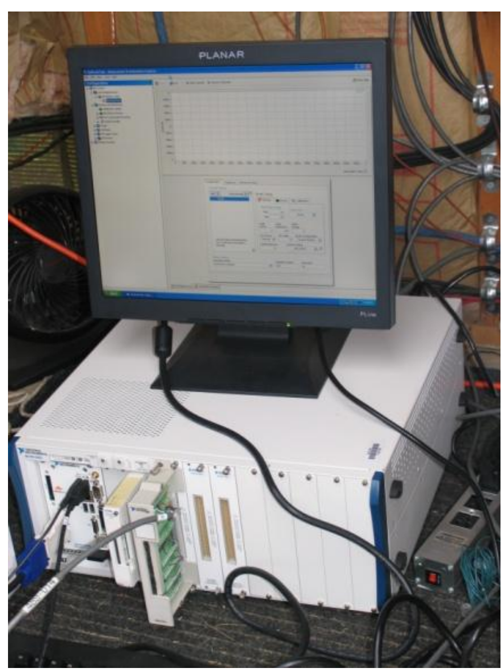


Figure 5-7 Computer Recording Strain data with datalogger

Figure 5-9 Setup of Wires running from Pavement

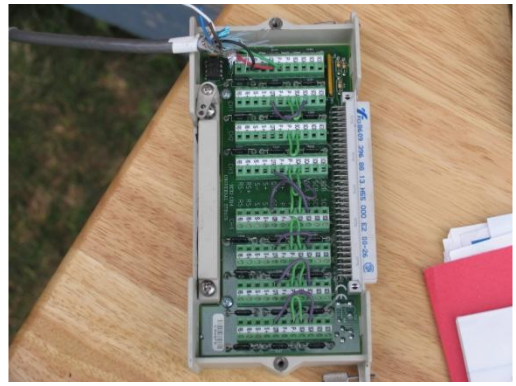


Figure 5-8 Data Logger

HMA Strain Gauges

In addition to the two sets of soil gauges, twelve Pavement Strain Transducers (PAST) II Hot mix Gauges are installed at the site as seen in Figure 5-10. Four locations within the test section contain the sensors (three PAST per location). At each selected location within the site, one sensor is closest to the predicted middle of the wheel path and the other two were placed on either side of the center about seven to eight cm apart. The gauges are laid out in the longitudinal direction at two of the locations and transversely at the remaining two. In order to secure the gauges in place, a small fiber strip was placed prior to the HMA base course and covered with a thin mixture of asphalt binder and sand. The gauges were than pressed onto the mix and the appropriate wires connected to the data acquisition system. A small amount of HMA was then shoveled over the gauges and hand compacted before regular paving. The gauges have a range of 1500 micro strain and the quarter bridge has an effective length of 102 mm. [75]

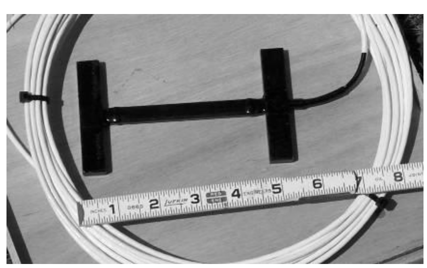


Figure 5-10 Asphalt Strain Gage

6. Results

6.1. Traffic Data

Below in Figure 6-1, the traffic by vehicle classification is shown per season. It is important to know which vehicle classifications are predominant in each season because the weight of the vehicle is a major consideration when designing the pavement. Also, with a change in seasons there is a change in properties of the HMA layer – HMA is stiffer at lower temperatures.

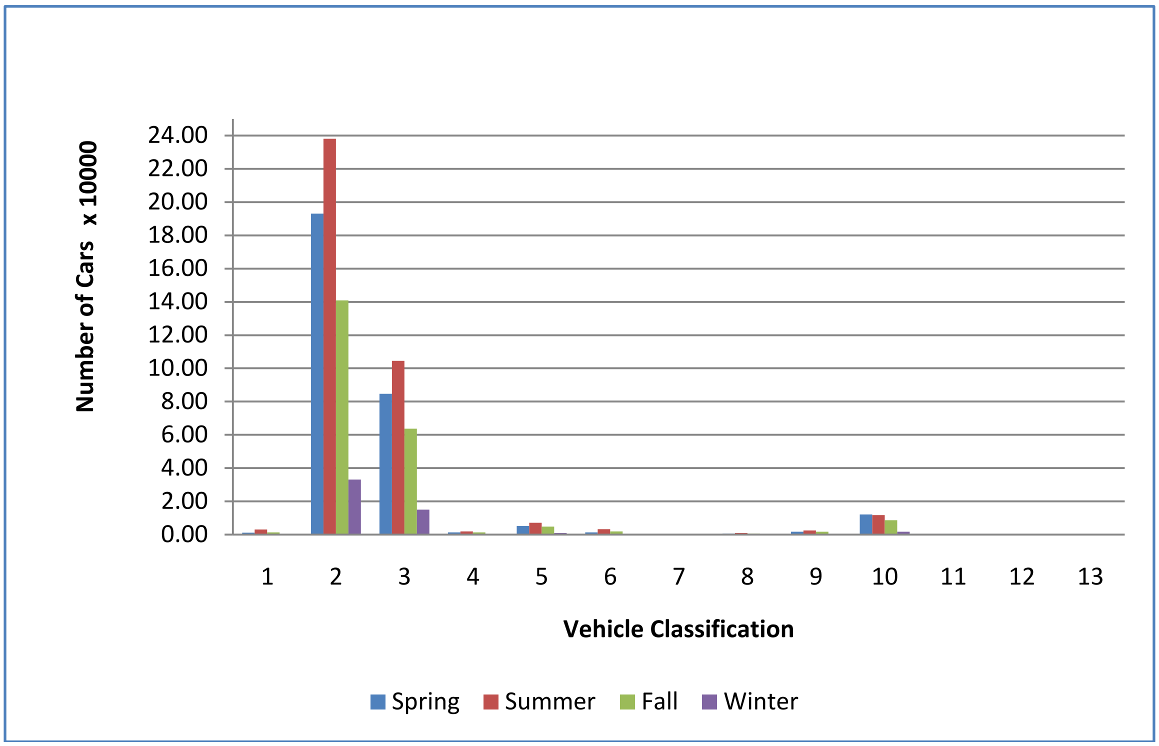


Figure 6-1 Seasonal Traffic Variation For Test Segment in Guilford Maine

The following graph is a seasonal comparison of the weight distributions of the vehicles traveling on the test strip. It is clearly shown that back axle carried a heavier load for every season compared to the front axle. Also, the graph shows that there was a slightly higher back axle load in the summer, so there must have been more truck traffic in the summer.

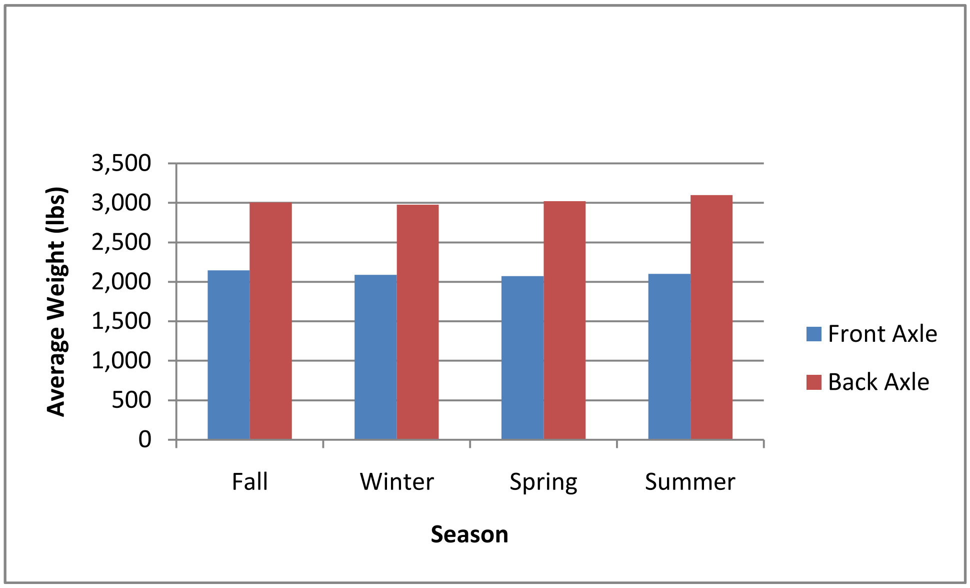


Figure 6-2 Weight Distribution Comparison By Season

6.2. Environmental Data

Thermocouple results

The different temperatures of the layers in the pavement have significant effects on pavement responses and hence the design of the pavement. The pavement design must handle the stress levels in each asphalt layer. The changes in stiffness of the existing HMA with a change in temperature must be accounted for in design of the new pavement or it will fail.

The analysis started with the creation of a graph of the thermocouple data that showed the average temperatures of each layer for the months of data that was obtained. Figure 6-3 shows that in both months of October and November, the second layer retained its heat longer than the first and second layer. The graph also portrays that the lowest layer, Layer 3, had the lowest temperature. Lastly, the graph shows a substantial decrease in average temperature from 14.8 down to 7 degrees between October and November. The raw data for this analysis can be found in Appendix 11.C

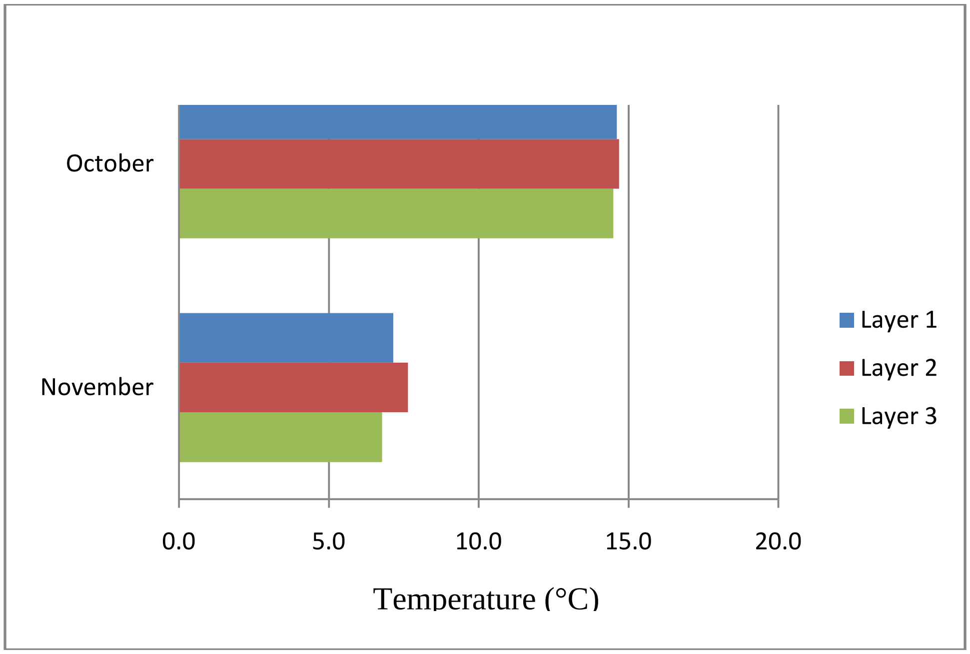


Figure 6-3: Average Layer Temperature in HMA Layers

To further understand the changing of the temperature change, the data was broken down into hours. Each hour for the week was averaged and compared with the change in temperature for a month. Figure 6-4, Figure 6-5 and Figure 6-6 show the changes in temperature for the weeks for each layer. The Graphs show subtle but important details to how the pavement responds to the cold weather. One noticeable unexpected string of data was the second week in the month being warmer than the rest of the other weeks. We also see that the peak temperatures for Layer 1 at 3pm, Layer 2 at 5pm, and Layer 3 at 3pm. It was also noticed that the changes in temperature were large for Layers 1 and 2 compared to Layer 2. These graphs show us again that the second layer takes longer to heat up and is less responsive to the cold.

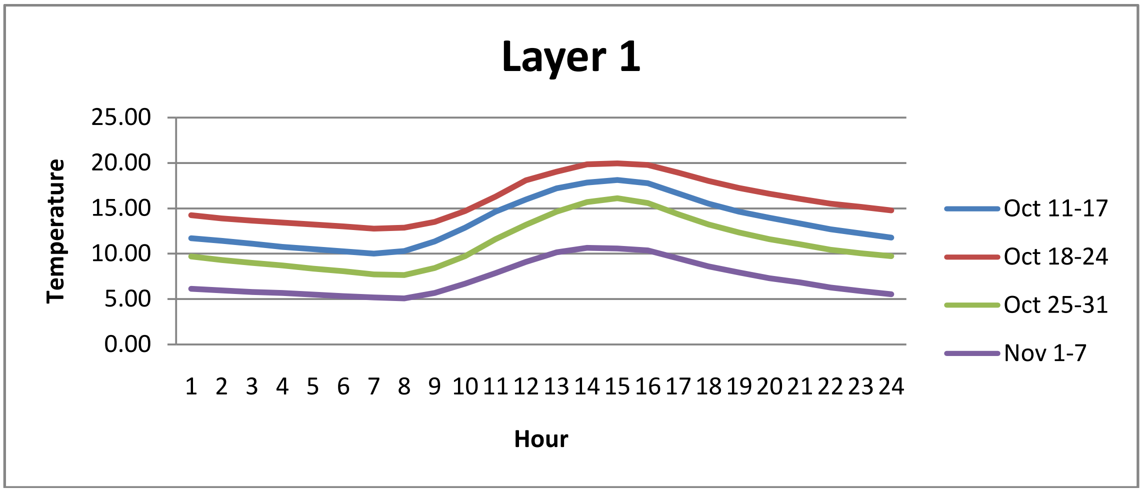


Figure 6-4: HMA Layer 1 Hourly Temp Change

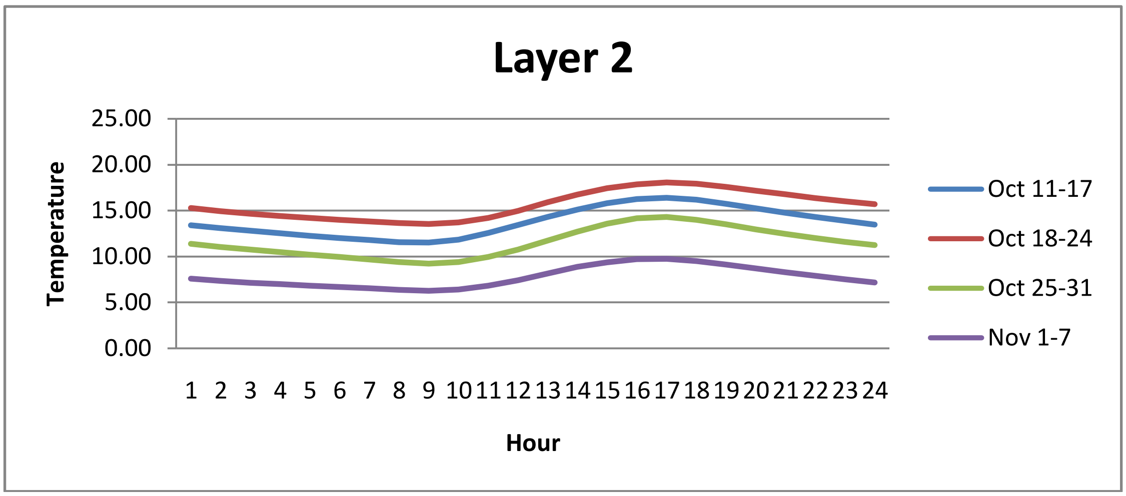


Figure 6-5: HMA Layer 2 Hourly Temp Change

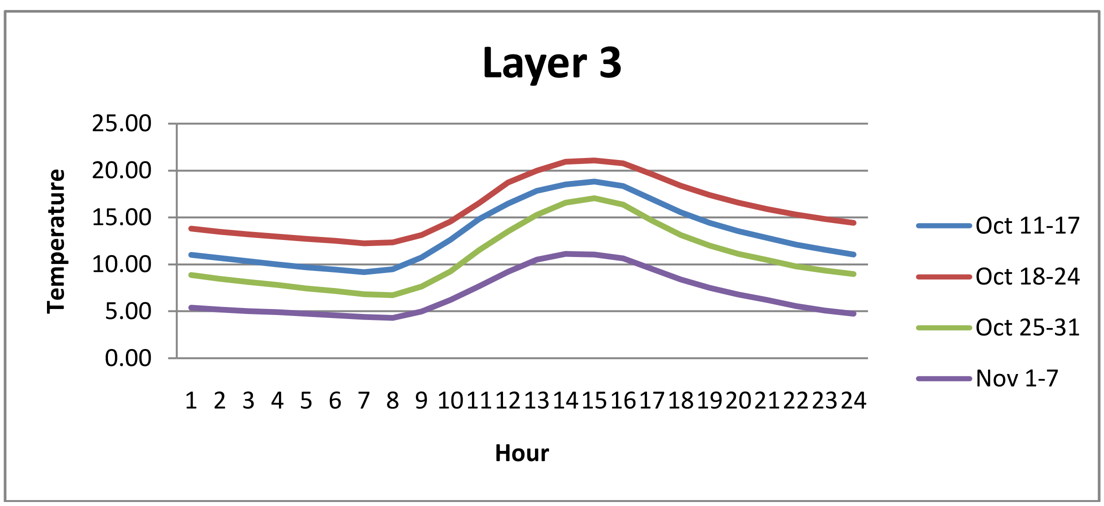


Figure 6-6: HMA Layer 3 Hourly Temp Change

The next analysis conducted was to understand the change in temperature based on the depth of each pavement layer. Below in Figure 6-7, we see the temperature graphic verse the depth in the pavement. This is important to know since the ground will freeze from the top down. We can see that there is more of a change between the first and second layer than the first and third. This tells us that there is more of a variation in temperature near the surface of the pavement.

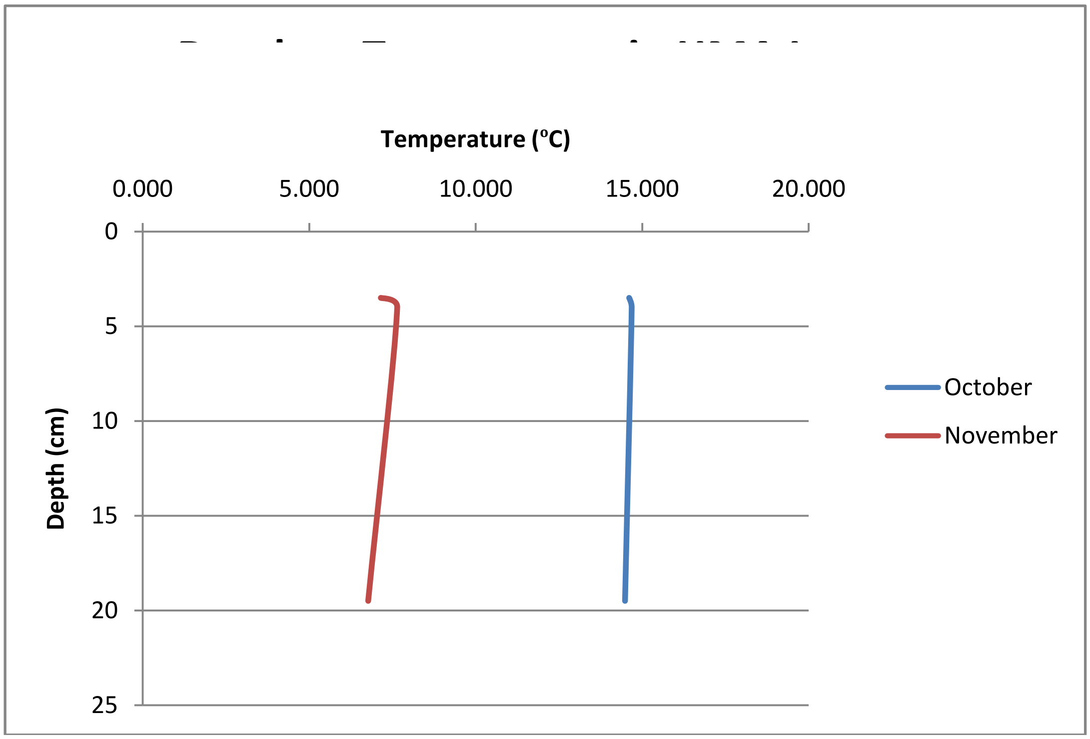


Figure 6-7: Depth Versus Temperature in HMA Layers

6.3. Thermocouple/Traffic Comparison:

It is important to understand the relation of the temperature in the pavement with the volume of traffic on the road. We started out by selecting the week of October 14, 2007 through October 20, 2007 since there was data available for both the traffic volume and thermocouples. We then made a comparison based on an hourly basis for each day of the week as show in Figure 6-8, Figure 6-9 and Figure 6-10.

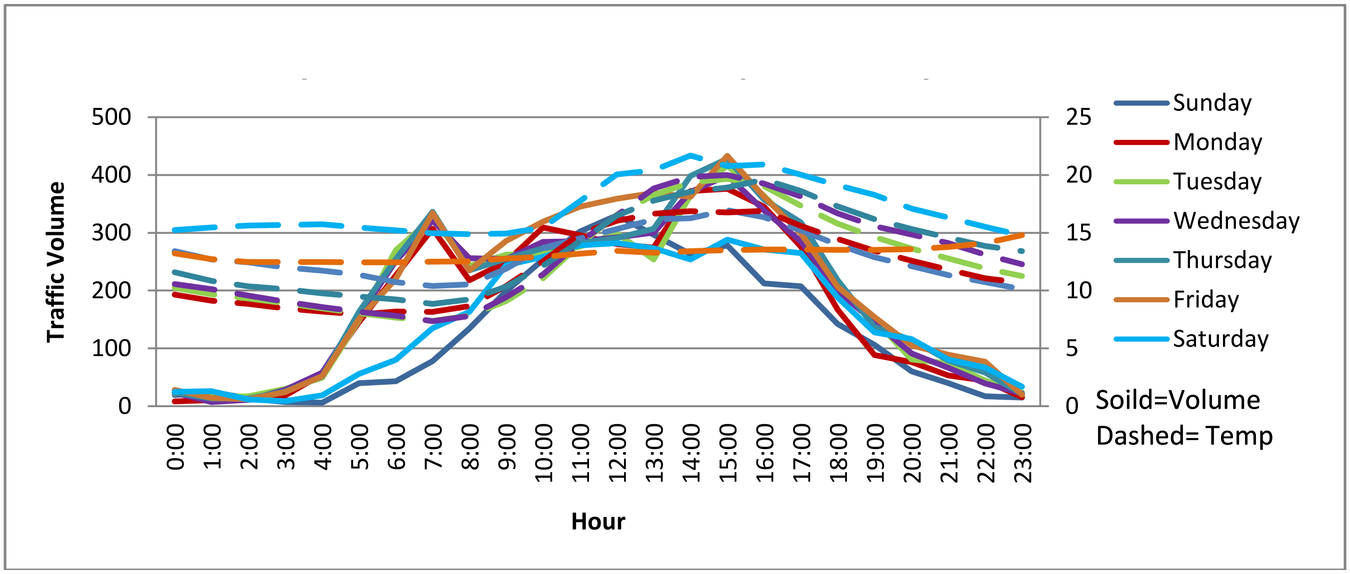


Figure 6-8: Layer 1 Vol and Temp per Hour

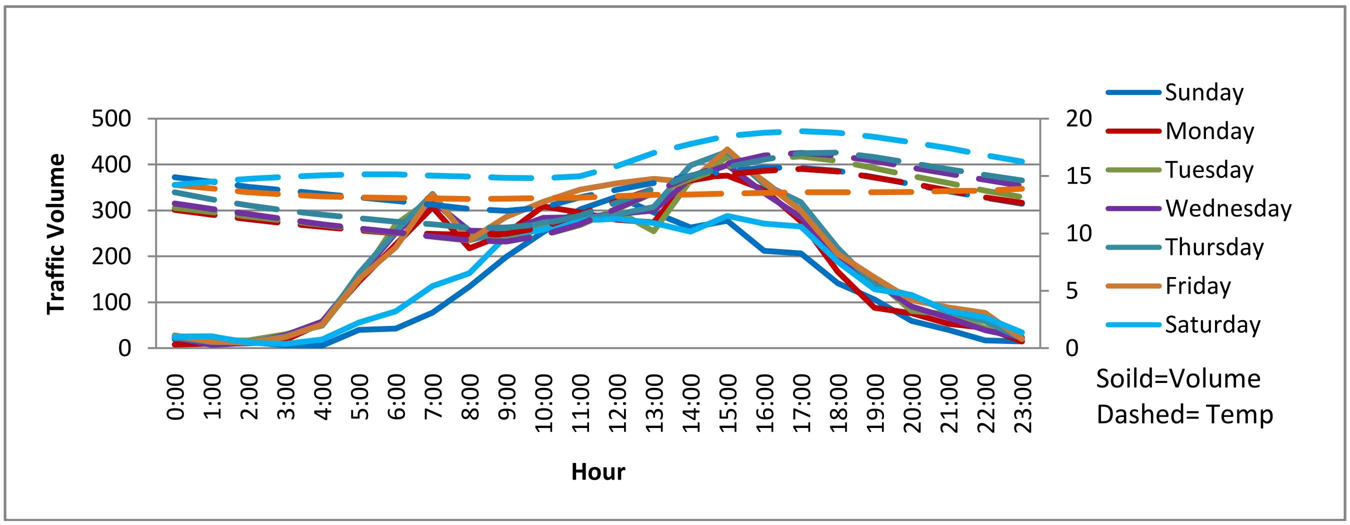


Figure 6-9: Layer 2 Vol and Temp per Hour

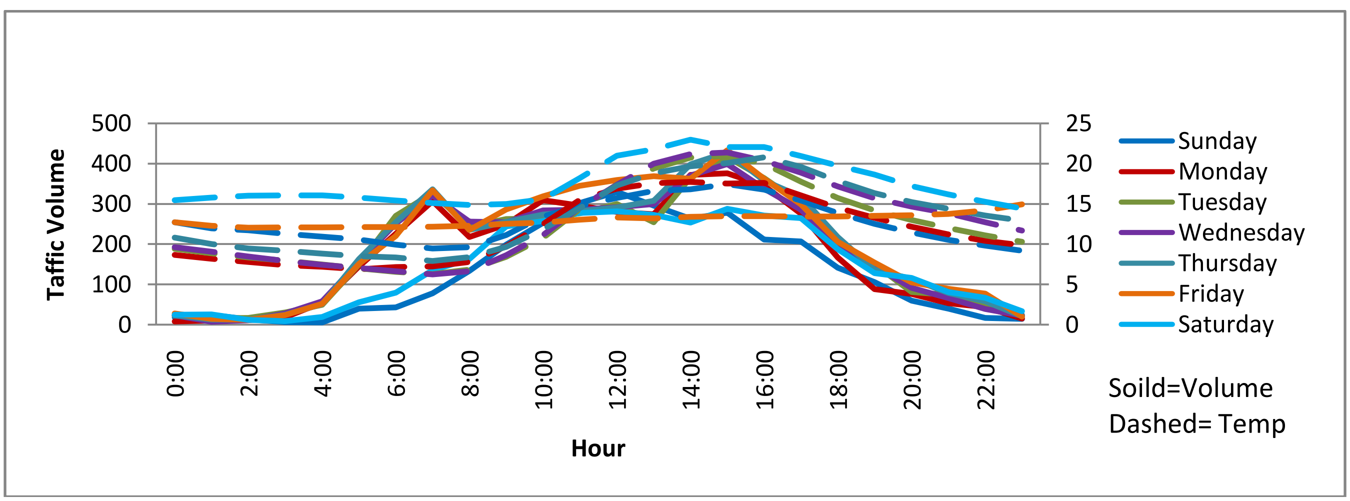


Figure 6-10: Layer 3 Vol and Temp per Hour

Then to get a more detailed look at the traffic and temperature data, the peak traffic volume was graphed with the corresponding temperatures. The peak volume of traffic was around 3pm in the afternoon. Since this time had the highest traffic volume, it has the worst conditions to design against. As Figure 6-11 portrays, the pavement was decreasing in temperature on the traffics highest volume day, Thursday, with around 400 vehicles per hour. These existing conditions will help in the design of the new pavement structure.

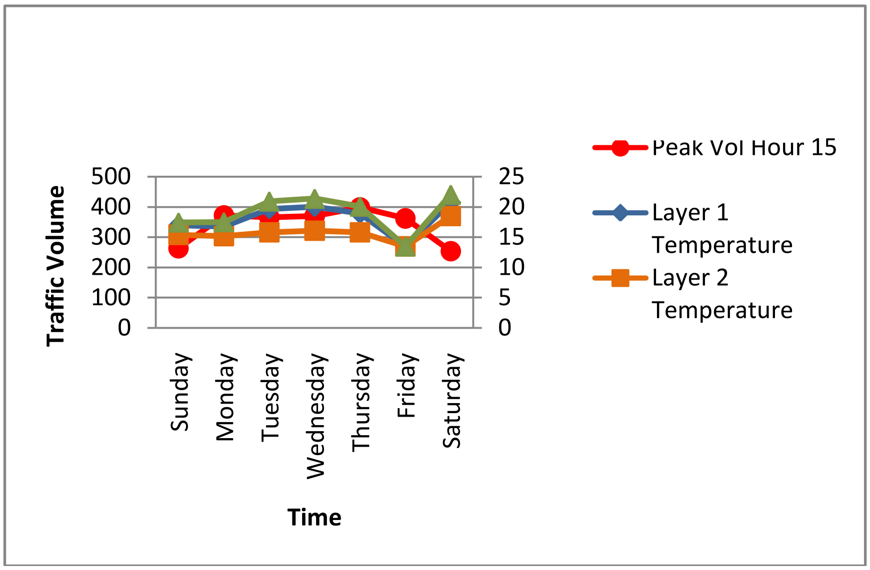


Figure 6-11: Peak Traffic Volume with Temperature

To do appropriate analysis of the data we needed to be able to use both the enviromental and traffic data. We choose the week of October 14th to 20th because it was the only week for which we had complete insitu temperature and traffic data. Below Figure 6-12 shows that for layer 1 the maximum temperature was 18.07ºC and the minimum temperature was 9.94ºC.

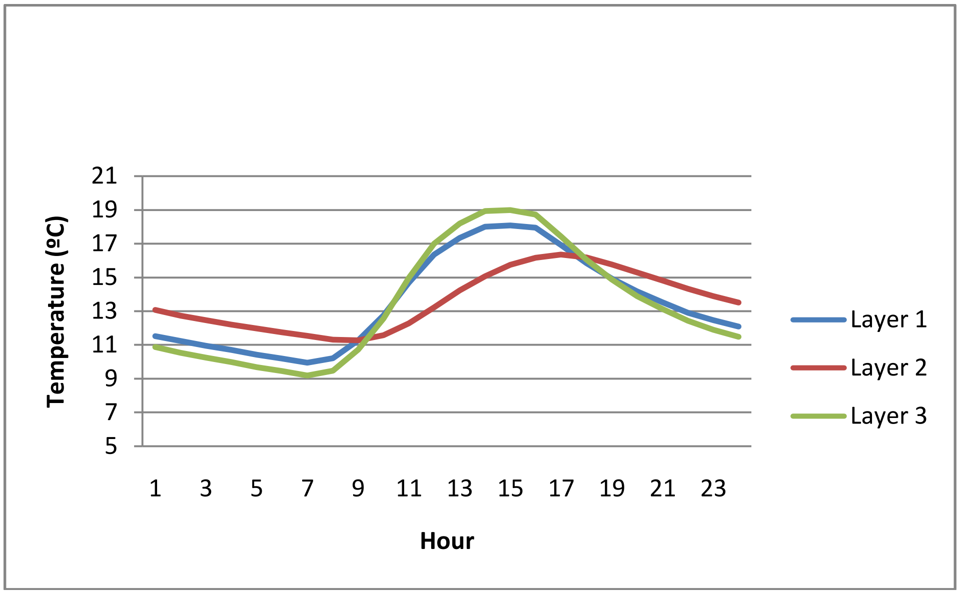


Figure 6-12 HMA Average Temperature Versus Hourly Temp Change for analysis week

7. Analysis

The in-place data that was collected allows for a very thorough analysis of the pavement response for the target week, October 14th to 20th. A pavement analysis program called EverStress was used to determine the tensile and compression strains that are resulting from the traffic loading and environmental conditions that are at the Guilford, Maine test site. The calculated strain data will then be compared against the actual strain values collected from the strain gauges to evaluate the effectiveness of using EverStress to estimate the strain which occurs in a pavement structure.

7.1. Input Data

Layer Data

The layer input data that was used is the actual properties of the pavement section in Maine. Layers 1 through 3 are the HMA layers, layer 4 is the subbase and layer 5 is the subgrade. It was assumed that the moduli of the layers were stress insensitive, as indicated by the value of "0" entered for the Layer ID column in Table 7-1. Poisson's Ratio was assumed 0.35 for the first layer of HMA and 0.4 for the other layers.

Table 7-1 Layer Input Data for the EverStress Analysis

Layer	Layer ID	Interface Contact	Poisson's Ratio	Thickness (cm)	Mr (MPa)
1	0	1.00	0.35	3.5	**Mr,f(t)**
2	0	1.00	0.4	4.0	2000
3	0	1.00	0.4	19.5	2000
4	0	1.00	0.4	51	150
5	0	1.00	0.4	-	20

The resilient modulus values were assumed average values for layers 2, 3, and 4. However, for the first HMA layer one value cannot be used because the modulus value varies with temperature. For our target week the temperature ranged from 10ºC to 18ºC. Therefore, investigation and analysis of a previous study of the test site was utilized. In this study resilient modulus tests were conducted on HMA cores taken from a typical Maine DOT state road, the results of which are found in Table 7-2.

Table 7-2 Resilient Modulus Versus Temperature from a typical Maine DOT state road

			Resilient Modulus, Mpa											
Temprature (ºC)			10			20			30			40		
		Axis	X	Y	Avg.	X	Y	Avg.	X	Y	Avg.	X	Y	Avg.
ME 2A	1	1	3557	4236	3897	2498	2249	2374	496	587	541	282	279	280
ME 2A	1	3	5939	6060	6000	2832	3699	3266	653	571	612	316	324	320
ME 2A	1	7	5524	6435	5980	2598	2938	2768	676	431	554	349	312	331
ME 2A	2	1	5215	4442	4829	2246	2141	2194	684	683	683	340	272	306
ME 2A	2	3	4590	2928	3759	2020	2072	2046	506	571	539	342	301	322
ME 2A	2	7	4220	4226	4223	2388	2057	2223	639	795	717	396	461	429
ME 2A	3	2	4762	4349	4556	2497	2799	2648	668	499	583	377	443	410
ME 2A	3	4	4391	4919	4655	2320	3115	2718	701	923	812	426	295	360
ME 2A	3	6	5104	4725	4915	2831	2884	2858	1023	665	844	337	450	393
				Average	4757		Average	2566		Average	654		Average	350

The average values were calculated for each temperature provided, they were then graphed and a regression equation was determined, as shown in Figure 7-1.

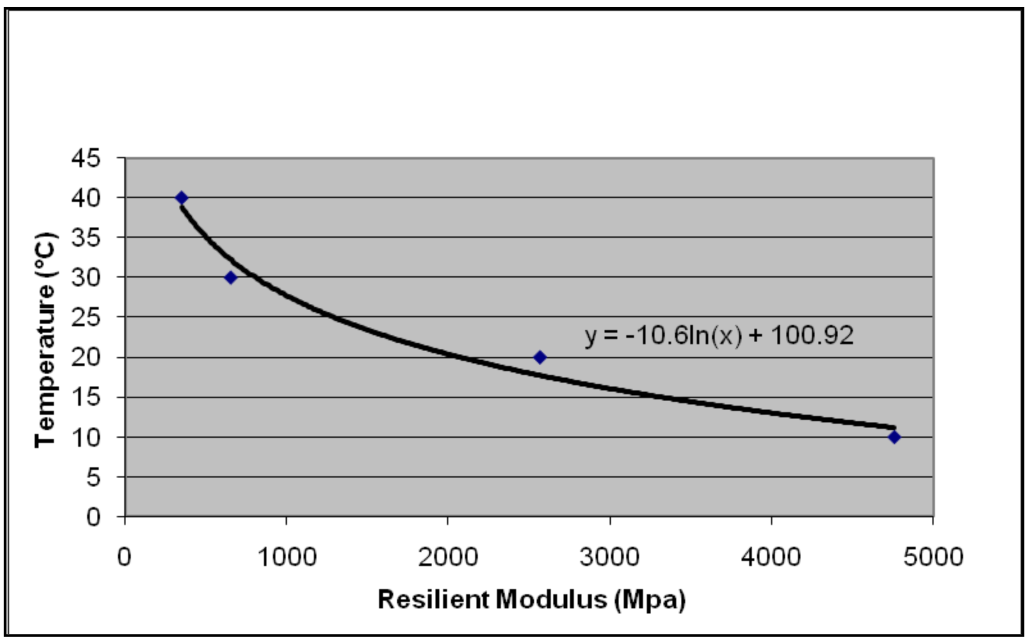


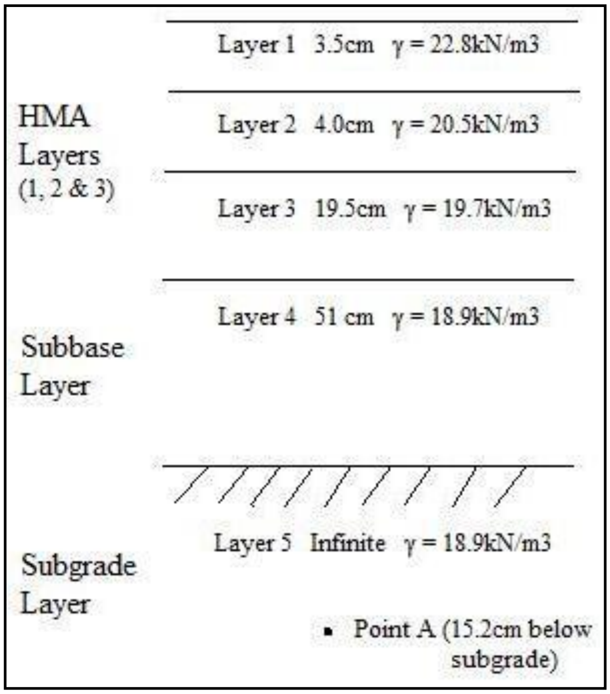
Figure 7-1 Modulus Correlation With Temperature

Using the equation provided from the above graph, the following Mr values for the first HMA layer were determined for each of the corresponding temperature values. These Mr values was used in the EverStress analysis.

Table 7-3 Modulus Values for EverStess Analysis

October 14th to 20th	
Temperature (°C)	Mr (Mpa)
10	5,323
11	4,844
12	4,407
13	4,011
14	3,649
15	3,321
16	3,022
17	2,750
18	2,502
19	2,277

The next step was to determine the modulus value for the subgrade layer. To do this, the stresses in the layer needed to be first calculated. The geostatic stress, σ_Z, or the stresses only due to the layer weights and thickess was determined to be 18 kN/m^2 using the layer data shown in Figure 7-2.



γ= Unit Weight

Figure 7-2 Layer Properties and Dimensions for Geostatic Calculations and EverStress Analysis

The other stresses that occur in the pavement are induced stresses due to traffic loading. However, before the lengthy calculations were preformed a trial EverStress analysis was run to determine if there was a significant amount of stresses occurring due to the loading to warrant determining the modulus for each loading condition. For the analysis 20 MPa was assumed for the subgrade layer, average of 2000 MPa for the first HMA layer and a Class 6 vehicle was chosen. The complete input data used can be found in Table 7-4 below as well as the EverStress output file in the Appendix. Further explanation of input data used will be covered in the next section.

Table 7-4 Input Data Used To Determine Response In Subbase Layer

Class 6			
No. Loads	5	No. of x-y Eval. Points	6

Load Information					
x-position (cm)	0	32.92	0	32.92	0
y-position (cm)	0	0	777.24	777.24	1219.2
Load (N)	311	311	304	304	329
Pressure (kPa)	690	690	690	690	690
Radius (cm)*	-	-	-	-	-
tire location	3rd axle	3rd axle	2nd axle	2nd axle	1st axle

Evaluation Points						
x-position	0	1.3716	0	1.3716	0	1.3716
y-position	0	0	33.72	33.72	67.44	67.44
z-position	3.499	3.499	3.499	3.499	3.499	3.499
z-position	5.5	5.5	5.5	5.5	5.5	5.5
z-position	17.25	17.25	17.25	17.25	17.25	17.25
z-position	52.5	52.5	52.5	52.5	52.5	52.5
z-position	78.001	78.001	78.001	78.001	78.001	78.001

As, the output file shows, there were no additional stresses. This was found by looking at the stress and strain values which corresponding to the z-position of 78.001 cm or just into the subbase. Therefore, there was no need to have the modulus vary with loading so 20 MPa was assumed as an average modulus value for the subgrade.

Picking Analysis Points

After inputting the layer information, the location of tire loading on the road by the vehicle is inputted. In EverStress, the only half of the vehicle is modeled. For instance, imagine standing behind a car and thinking about how the car is loaded. If you assume that the car distributes the weight evenly from left to right, then it is possible to analyze only one side of the vehicle because they will have the same output for either side. Once a coordinate axes in placed on the vehicle, the tire locations can be determined. The last set of information that needs to be entered is where to evaluate the stress and strains at. The points can be set anywhere parallel or perpendicular to the pavement structure. It was assumed for setting the location of the tires and the evaluation points that the x-direction was along the width of the car and pavement section, the y-direction was along the length of the car or pavement section and the z-direction was the depth into the pavement. The coordinate (0,0,0), which corresponds to (x,y,z), was placed on the surface of the pavement under the driver's side back tire.

The analysis began by investigating each vehicle classification's configuration. This approach was found to be unsuccessful as the reliability of the WIM data became suspect. Therefore, a more theoretical approach was taken where just the basic tire configurations which make up each of the classifications, single, tandem and tridem, where used instead. The following sections go into more detail of the process that was conducted for each analysis protocol and what valuable information resulted. It should be noted that all the data was summarized by either classification or axle type, depending on analysis, into Excel Spreadsheets.

7.2. Analysis By Vehicle Classification

Tire Loading Coordinates determined

In order to determine proper pavement loadings from vehicles, it is necessary to determine at which points these loadings occur. In this study the loading points were selected at the middle of each tire on a vehicle. Vehicles were separated into the different vehicle classes and assigned x and y direction coordinates. X coordinates are from right to left on the vehicle and y direction is from back to front of the vehicle with the viewpoint of looking from the back towards the front of the vehicle. Therefore the (0,0) coordinate of each vehicle is the most back-left tire. Each class tire locations were determined from the AASHTO "Policy on Geometric Design of Highways and Streets" for classes two through four[76]. Classes five through ten used the NCHRP "Review of Truck Characteristics as Factors in Roadway Design" for tire locations[77]. These tire coordinates also assume that the spacing of tires side by side, in the x coordinate direction is thirteen inches (33.02 centimeters). Only one side of each vehicle is analyzed, as the load is assumed to be evenly loaded per side. These coordinates can then be entered into the loading analysis software and used to generate results. The following figures, Figure 7-3, Figure 7-4, and Figure 7-5, illustrate what coordinates were used for all of the calculations in cm:

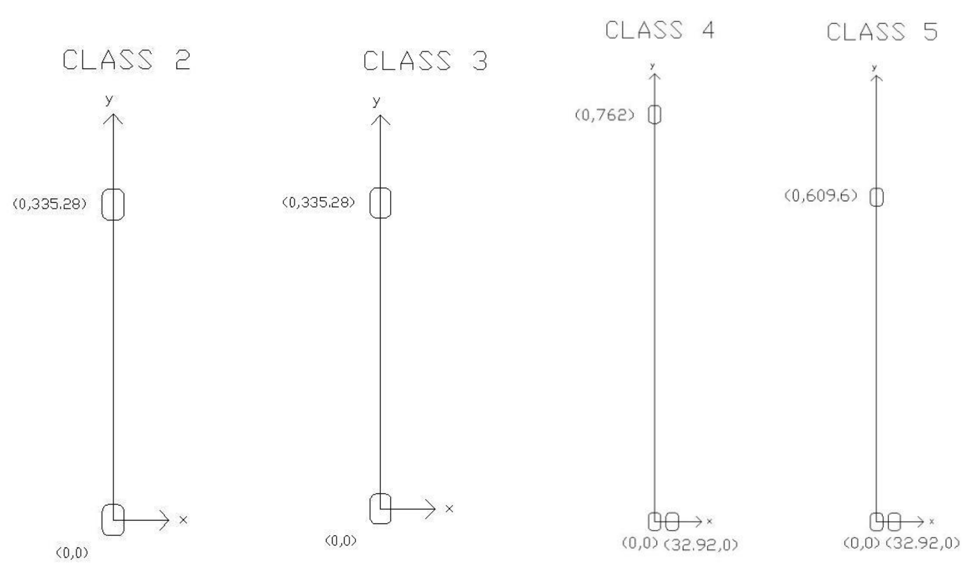


Figure 7-3 Tire Coordinate Positioning Classes 2-5

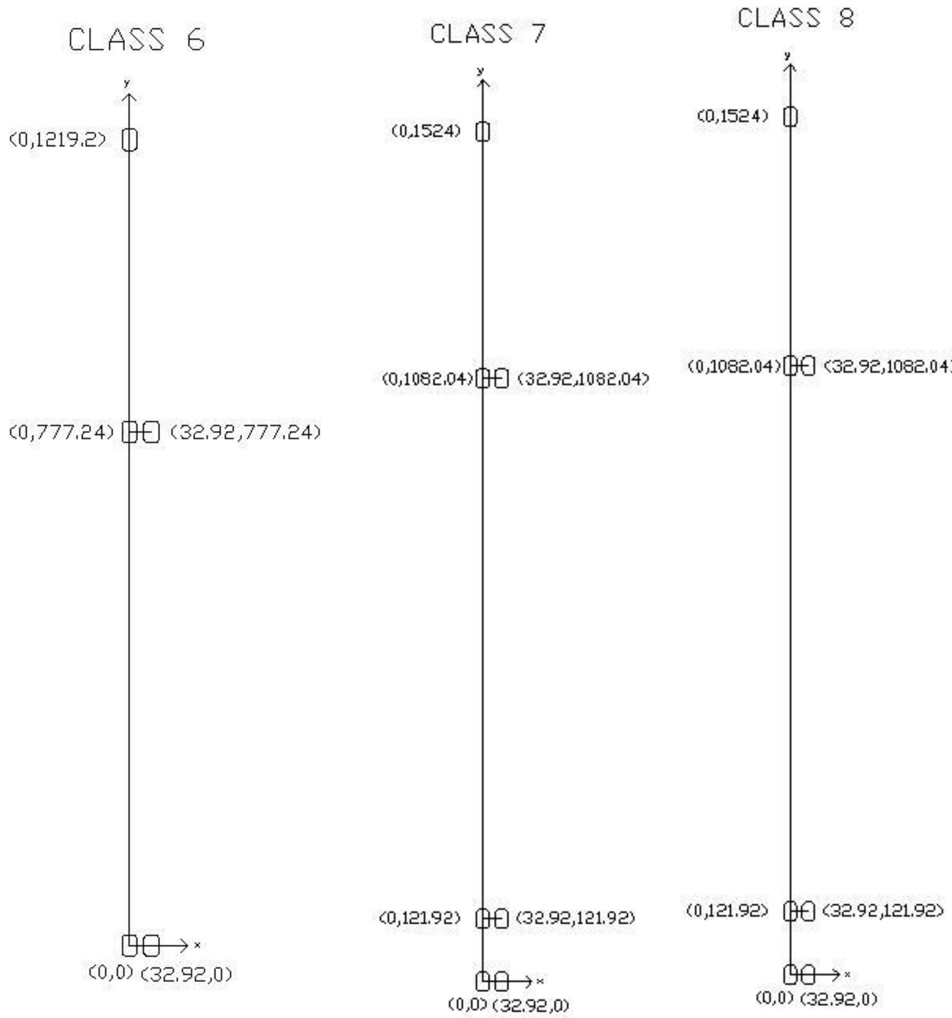


Figure 7-4 Tire Coordinate Positioning Classes 6-8

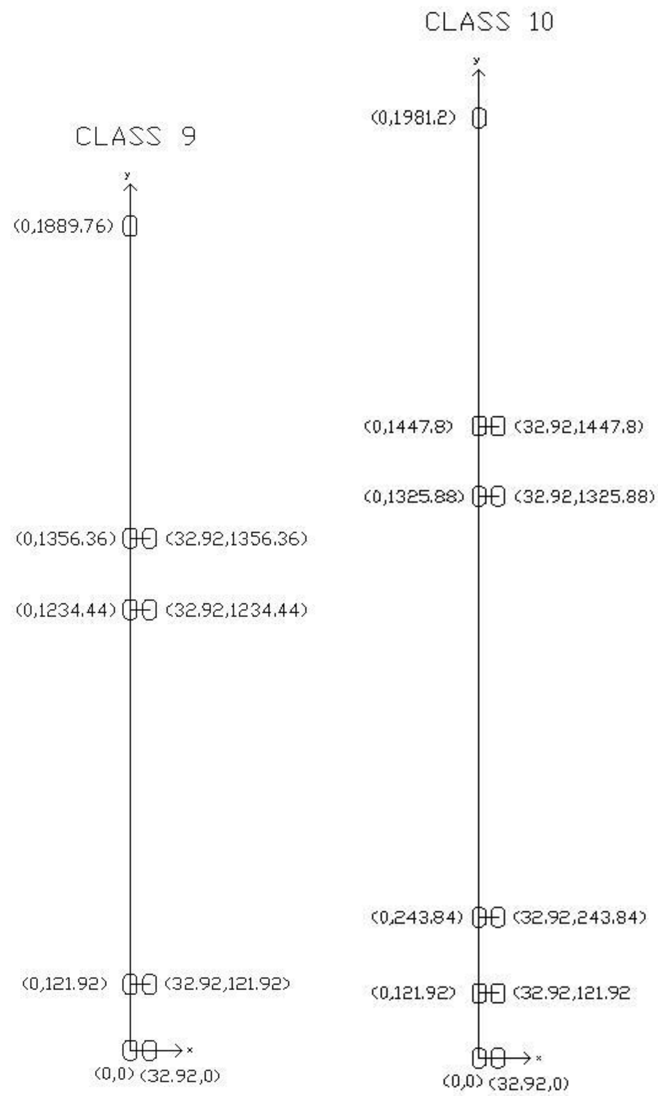


Figure 7-5 Tire Coordinate Positioning Classes 9-10

Evaluations Points

The evaluation points chosen in the x-y plane were at a point right under a tire, at a midpoint between tires in the x-direction, and at a midpoint in the y-direction. These points correspond to possible maximum stress/strain values. The evaluation points in the z-direction, depth, can be automatically entered by the program but it is important that the tensile strain is found at the bottom of the HMA layer to determine the extent of possible fatigue related distress, and the vertical compression strain is found at the top of the subgrade layer to determine the extent of possible rutting. Therefore, the z-direction evaluation points chosen were at 26.999 cm, the bottom of the HMA layer and 79.999 cm, at the top of the subgrade layer.

Loading

The loading on each tire was determined from a study conducted in conjunction with this by Christine Conron, a Worcester Polytechnic Institute graduate student. As part of her own study of the traffic data collect from the WIM, the weight data was summarized for our test week by axle number. The data was sorted further to find only the maximum weight per axle because the most conservative values are best to use to find the maximum stress and strain that the pavement endures. The weights were entered as Newton (N). In Table 7-5, the axle count is from the front of the vehicle to the back.

Table 7-5 Adapted Maximum Axle Weight for Test Week

Axle Number	Maximum Weight (kips)	Maximum Weight (N)
1st Axle	32.9	146,339
2nd Axle	30.4	135,219
3rd Axle	31.1	138,333
4th Axle	28.0	124,544
5th Axle	29.1	129,437
6th Axle	30.2	134,330
7th Axle	n/a	n/a

Now that the layer information, loading points and weight, and evaluation points were known, it was time to begin the process of analyzing each classification under the maximum loading scenario and for each of the temperatures within our test range could begin. To expedite the analysis, sample input files were created in Excel for each of the classes, which can be found in the Appendix. However, this input data was found to be flawed. It was not logical to take the maximum weight per axle and apply it to every classification because each classification, or vehicle type, will only experience a maximum axle load for which occurs within its own classification. Therefore the data was summarized into tables of the maximum axle weight for each classification as seen in the figures below. Below each load input table is its corresponding loading and evaluation point input sheets.

Table 7-6 Class 2 Loading

Class 2			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	0.8	5.9	26,243
2nd Axle	0.6	5.8	25,798
3rd Axle	0.4	2.6	11,565
4th Axle	0.9	1.6	7,117
5th Axle	n/a	n/a	n/a
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-7 Class 2 Load and Evaluation Locations

Class 2			
No. Loads	2	No. of x-y Eval. Points	1

Load Information		
x-position (cm)	0	0
y-position (cm)	0	335.28
Load (N)	12,899	13,122
Pressure (kPa)	220.63	220.63
Radius (cm)*	-	-
Axle	2nd	1st
Number of Tires per Axle	2	2

Evaluation Points (cm)	
x-position	0
y-position	0
z-position	26.999
z-position	77.999
z-position	
z-position	
z-position	

Table 7-8 Class 3 Loading

Class 3			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	1.2	5.8	25,798
2nd Axle	1.1	9.5	42,256
3rd Axle	0.3	4.9	21,795
4th Axle	0.4	3.7	16,458
5th Axle	0.3	1.4	6,227
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-9 Class 3 Load and Evaluation Locations

Class 3

No. Loads	2	No. of x-y Eval. Points	1

Load Information		
x-position (cm)	0	0
y-position (cm)	0	335.28
Load (N)	21,128	13,122
Pressure (kPa)	220.63	220.63
Radius (cm)*	-	-
Axle	2nd	1st
Number of Tires per Axle	2	2

Evaluation Points (cm)	
x-position	0
y-position	0
z-position	26.999
z-position	77.999
z-position	
z-position	
z-position	

Table 7-10 Class 4 Loading

Class 4			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	5.1	38.8	172,582
2nd Axle	5	50	222,400
3rd Axle	4.9	20.9	92,963
4th Axle	n/a	n/a	n/a
5th Axle	n/a	n/a	n/a
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-11 Class 4 Load and Evaluation Locations

Class 4			
No. Loads	3	No. of x-y Eval. Points	3

Load Information			
x-position (cm)	0	32.92	0
y-position (cm)	0	0	762
Load (N)	55,600	55,600	86,291
Pressure (kPa)	690	690	690
Radius (cm)*	-	-	-
Axle	2	2	1
Number of Tires per Axle	4	4	2

Evaluation Points (cm)			
x-position	0	16.46	32.92
y-position	0	0	0
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Table 7-12 Class 5 Loading

Class 5			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	2.2	19.5	86,736
2nd Axle	3.4	26.5	117,872
3rd Axle	1.8	10.3	45,814
4th Axle	1.4	8.5	37,808
5th Axle	2.8	4.6	20,461
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-13 Class 5 Load and Evaluation Locations

Class 5			
No. Loads	3	No. of x-y Eval. Points	3

Load Information			
x-position (cm)	0	32.92	0
y-position (cm)	0	0	609.6
Load (N)	29,468	29,468	43,368
Pressure (kPa)	690	690	690
Radius (cm)*	-	-	-
Axle	2	2	1
Number of Tires per Axle	4	4	2

Evaluation Points (cm)			
x-position	0	16.46	32.92
y-position	0	0	0
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Table 7-14 Class 6 Loading

Class 6			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	6.2	18.3	81,398
2nd Axle	3.5	23.5	104,528
3rd Axle	2.2	23.7	105,418
4th Axle	n/a	n/a	n/a
5th Axle	n/a	n/a	n/a
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-15 Class 6 Load and Evaluation Locations

Class 6

No. Loads 5 No. of x-y Eval. Points 6

Load Information					
x-position (cm)	0	32.92	0	32.92	0
y-position (cm)	0	0	777.24	777.24	1219.2
Load (N)	26,354	26,354	26,132	26,132	40,699
Pressure (kPa)	690	690	690	690	690
Radius (cm)*	-	-	-	-	-
Axle	3rd axel	3rd axel	2nd axel	2nd axel	1st axel
Number of Tires per Axle	4	4	4	4	2

Evaluation Points (cm)						
x-position	0	16.46	0	16.46	0	16.46
y-position	0	0	388.62	388.62	777.24	777.24
z-position	26.999	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999	77.999
z-position						
z-position						
z-position						

Table 7-16 Class 7 Loading

Class 7			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	9.8	19.9	88,515
2nd Axle	3.3	30.4	135,219
3rd Axle	9.2	31.1	138,333
4th Axle	7.9	23.3	103,638
5th Axle	n/a	n/a	n/a
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-17 Class 7 Load and Evaluation Locations

Class 7

No. Loads	7	No. of x-y Eval. Points	5

Load Information							
x-position (cm)	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	1082.04	1082.04	1524
Load (N)	25,910	25,910	34,583	34,583	33,805	33,805	44,258
Pressure (kPa)	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-
Axle	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Table 7-18 Class 8 Loading

Class 8			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	3.2	22.2	98,746
2nd Axle	4.5	21.3	94,742
3rd Axle	1.4	24.3	108,086
4th Axle	3.1	28	124,544
5th Axle	n/a	n/a	n/a
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-19 Class 8 Load and Evaluation Locations

Class 8

No. Loads	7	No. of x-y Eval. Points	5

Load Information							
x-position (cm)	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	1082.04	1082.04	1524
Load (N)	31,136	31,136	27,022	27,022	23,686	23,686	49,373
Pressure (kPa)	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-
Axle	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Table 7-20 Class 9 Loading

Class 9			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	4.7	12.7	56,490
2nd Axle	5.9	25.2	112,090
3rd Axle	5.5	26	115,648
4th Axle	2.4	25.6	113,869
5th Axle	1.6	26	115,648
6th Axle	n/a	n/a	n/a
7th Axle	n/a	n/a	n/a

Table 7-21 Class 9 Load and Evaluation Locations

Class 9

No. Loads 9 No. of x-y Eval. Points 5

Load Information									
x-position (cm)	0	32.92	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	1234.44	1234.44	1356.36	1356.36	1889.76
Load (N)	28,912	28,912	28,467	28,467	28,912	28,912	28,022	28,022	28,245
Pressure (kPa)	690	690	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-	-	-
Axle	5	5	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Grey, not in analysis

Table 7-22 Class 10 Loading

Class 10			
Axle Number	Minimum Weight per Axel (kips)	Maximum Weight per Axel (kips)	Maximum Weight per Axel (N)
1st Axle	5.2	13.5	60,048
2nd Axle	5	27.2	120,986
3rd Axle	4.8	30	133,440
4th Axle	1.7	23.1	102,749
5th Axle	2.1	29.1	129,437
6th Axle	2.1	30.2	134,330
7th Axle	n/a	n/a	n/a

Table 7-23 Class 10 Load and Evaluation Locations

					Class 10						
No. Loads	11		No. of x-y Eval. Poi		5						

					Load Information						
x-position (cm)	0	32.92	0	32.92	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	243.84	243.84	1325.88	1325.88	1447.8	1447.8	1981.2
Load (N)	33,582	33,582	32,359	32,359	25,687	25,687	33,360	33,360	30,246	30,246	30,024
Pressure (kPa)	690	690	690	690	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-	-	-	-	-
Axle	6	6	5	5	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	4	4	4	4	2

	Evaluation Points (cm)				
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Grey, not in analysis

The first class which was analyzed was a class 6 vehicle. The input data which is portrayed in Table 7-22 and Table 7-23 above, as well as the value of Mr for a temperature of 9ºC as seen in Table 7-3, resulted in the following response data, as shown in Table 7-24.

Table 7-24 EverStress Output File for a Class 6 at 9 Degrees Celsius

CLayered Elastic Analysis by EverStress for Windows							
Title: Class 6, 9C							
No of Layers: 5	No of Loads: 5	No of X-Y Evaluation Points: 6					
Layer	Poisson's	Thickness	Moduli(1)				
*	Ratio	(cm)	(MPa)				
1	0.35	3.5	5,850				
2	0.4	4	2,000				
3	0.4	19.5	2,000				
4	0.4	51	150				
5	0.4	*	20				
Load No	X-Position	Y-Position	Load	Pressure	Radius		
*	(cm)	(cm)	(N)	(kPa)	(cm)		
1	0	0	26,354	690	11.026		
2	32.92	0	26,354	690	11.026		
3	0	777.24	26,132	690	10.98		
4	32.92	777.24	26,132	690	10.98		
5	0	1,219	40,699	690	13.702		
Location No: 1	**X-Position (cm): .000**	**Y-Position (cm): .000**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	395.87	465.45	-45.95	0	9.25	-0.01
77.999	4	29.28	30.32	-6.98	0.03	0.72	-0.01
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	114.04	162.74	-195.24	-18.018	0.54	901.997
77.999	4	132.97	142.66	-205.48	-22.801	-7.373	795.584
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-46.15	396.07	465.45	-195.38	114.17	162.74
77.999	4	-7	29.29	30.32	-205.61	133.1	142.66

Table 7-25 EverStress Output File for a Class 6 at 9 Degrees Celsius (Continued)

Location No: 2	X-Position (cm): 16.460	Y-Position (cm): .000					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	374.44	474.56	-46.57	0	0	0
77.999	4	30.9	31.38	-7.2	0.03	0	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	101.62	171.7	-193.09	-0.008	0.539	913.493
77.999	4	141.5	146.01	-214.08	0.017	-7.378	801.514
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-46.57	374.44	474.56	-193.09	101.62	171.7
77.999	4	-7.2	30.9	31.38	-214.09	141.5	146.01
Location No: 3	**X-Position (cm): .000**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.3	-13.64	-0.12	0	0.01	0
77.999	4	0.62	-4.37	-0.31	0.01	0.02	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.6	-6.74	2.73	-0.433	0.162	451.379
77.999	4	16.59	-29.93	7.92	-2.665	-3.709	453.943
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13.64	-0.31	-0.12	-6.74	2.6	2.73
77.999	4	-4.37	-0.31	0.62	-29.93	7.91	16.6

Table 7-26 EverStress Output File for a Class 6 at 9 Degrees Celsius (Continued)

Location No: 4	**X-Position (cm): 16.460**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.28	-13.69	-0.12	0	0	0.01
77.999	4	0.63	-4.38	-0.32	0.01	0	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.62	-6.76	2.73	-0.002	0.162	451.752
77.999	4	16.71	-30.05	7.91	0.079	-3.705	454.315
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13.69	-0.28	-0.12	-6.76	2.62	2.73
77.999	4	-4.38	-0.32	0.63	-30.05	7.91	16.71
Location No: 5	**X-Position (cm): .000**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	392.77	458.2	-45.62	0.05	9.17	0.01
77.999	4	29.15	28.81	-6.99	0.1	0.71	0.01
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	113.87	159.67	-193	-17.87	-2.815	982.276
77.999	4	136.14	132.96	-201.15	-22.613	-13.135	877.568
al Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-45.81	392.96	458.2	-193.14	114	159.67
77.999	4	-7	28.81	29.16	-201.28	132.96	136.28

Table 7-27 EverStress Output File for a Class 6 at 9 Degrees Celsius (Continued)

Location No: 6	**X-Position (cm): 16.460**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	371.12	467.05	-46.21	0.05	0	0.13
77.999	4	30.75	29.86	-7.21	0.1	0	0.05
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	101.39	168.54	-190.74	0.105	-2.806	993.568
77.999	4	144.58	136.32	-209.69	0.718	-13.089	883.349
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-46.21	371.12	467.05	-190.74	101.39	168.54
77.999	4	-7.21	29.86	30.75	-209.69	136.29	144.61

The data that we are interested in are the normal strains at 26.999 cm below the surface. This position corresponds to the bottom of the HMA layers. The stresses that occur at this point are pivotal in the creation of fatigue failure within the pavement structure. A summary of these values are in Table 7-28 and a pictorial representation of where these strains occur is in Figure 7-6. It should be noted that Exx corresponds to strain in the transverse direction and Eyy is the strain in the longitudinal direction. If the values are positive then it is in tension and if it is negative then it is in compression. As it can be seen in the pictorial representation the maximum transverse strain occurs at the driver's side back tire, 114.04 micro strains, and the maximum longitudinal strain occurs at the midpoint of the driver's side back tandem tires, 171.7 micro strains.

Table 7-28 Summary of Class 6 Strain Data At the bottom of the HMA Layer at 9ºC

			z-position (26.999cm)	
Location	x-postion	y-postion	Exx (10^{-6})	Eyy (10^{-6})
1	0	0	114.04	162.74
2	16.46	0	101.62	171.7
3	0	388.67	2.6	-6.74
4	16.46	388.67	2.62	-6.76
5	0	777.24	113.87	159.67
6	16.46	777.24	101.39	168.54

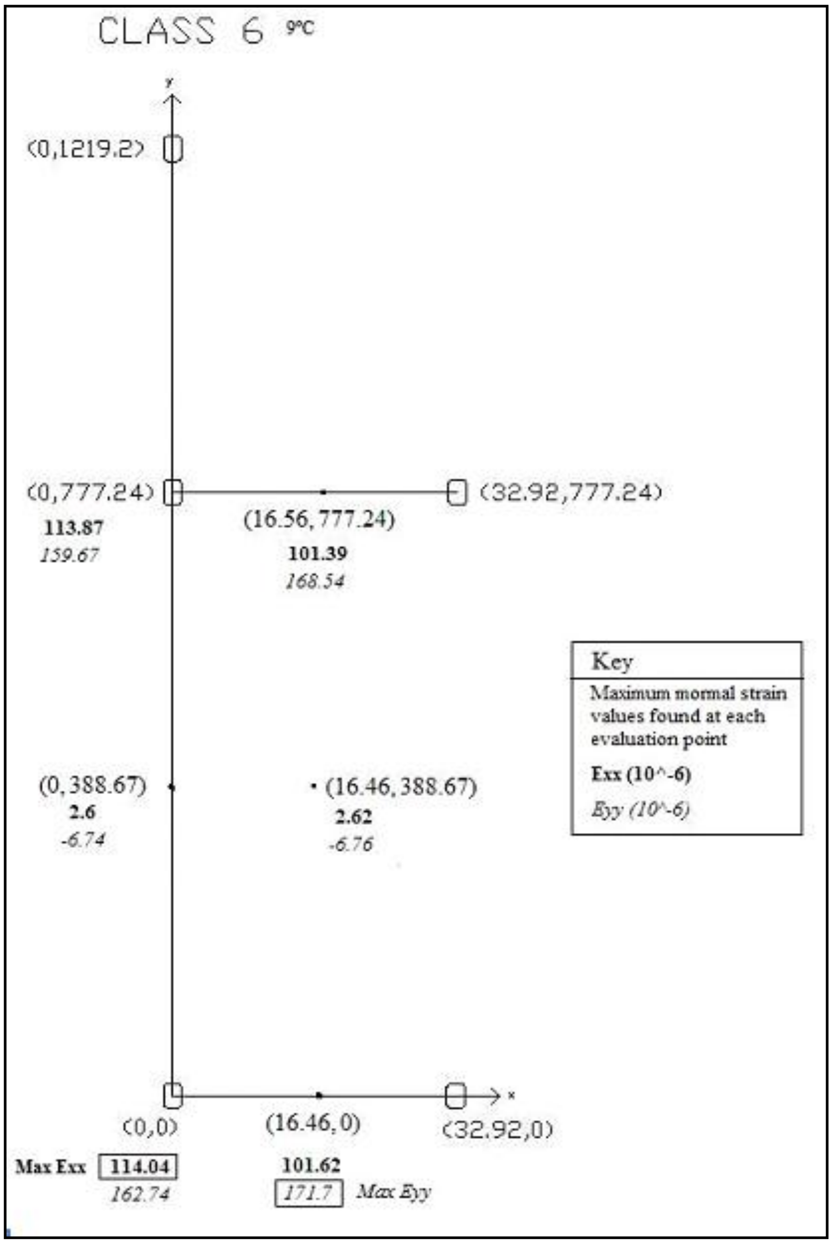


Figure 7-6 Class 6 Analyses at 9ºC

This same procedure was continued for 9ºC, 10ºC, 11ºC, 12ºC, and 13ºC. The output files can be found in the Appendix. The data is summarized in Table 7-29 and Figure 7-7. As the Table 7-29 shows the longitudinal direction resulted in higher tensile strains than the transverse direction, from 34% higher at 9ºC and 34% higher at 14ºC.

Table 7-29 Maximum Tensile Strain For A Class 6 Vehicle

Temperature (ºC)	Transverse (10^{-6})	Longitudinal (10^{-6})
9	114.04	171.7
10	114.5	172.65
11	114.98	173.61
12	115.46	174.58
13	115.95	175.57
14	116.45	176.57

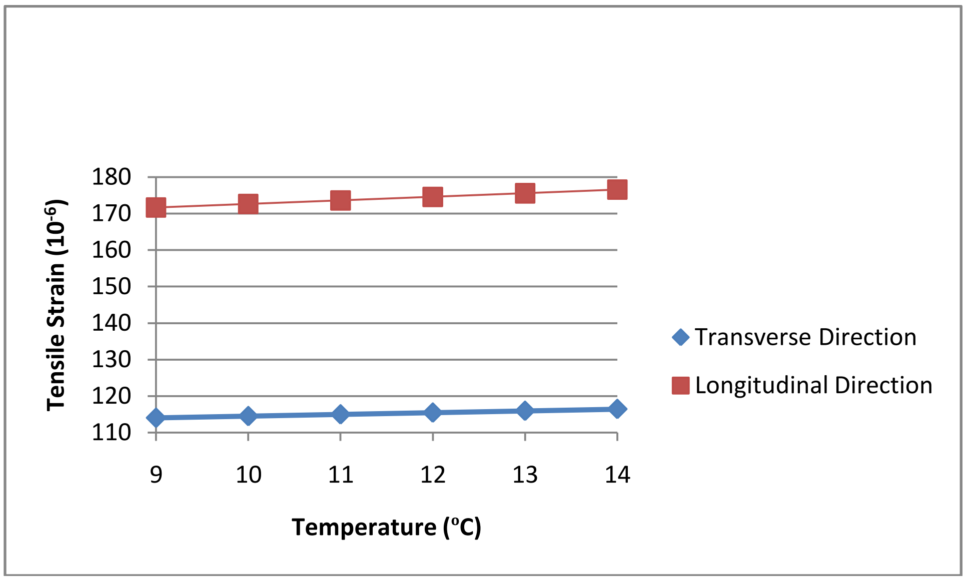


Figure 7-7 Class 6 Vehicle Tensile Strain Graph

The analysis halted at this stage in analysis when the reliability of the WIM weight per axel data was review again. Specifically class 5 vehicles only have 2 axle but the WIM recording them having up to five axles. It is believed at this time that the actual recording of the data was not flawed but the automatic grouping into vehicle classification may be flawed. This was quite concerning so a new direction was taken, theoretical analysis. The next section will describe the new analysis which was performed.

7.3. Analysis By Axle Configuration

Tire Loading and Evaluation Coordinates

Three types of axle configurations exist in an vehicle classifications, single, tandem and tridem. It is safe to assume that the spacing of tires side by side, in the x coordinate direction is 33 cm, which was what was used in the vehicle classification analysis. However, the spacing of the axles, in the y-direction, can vary greatly. By sorting though the WIM data and using the AASHTO[78] and NCHRP[79] as reference, it was found that the minimum distance between the axles was four feet and the maximum distance was five feet. The following figures illustrate what coordinates were used for all of the calculations. The large gray oval represents the tire locations, the smaller white circle is a midpoint between the tires and the red dots represent the evaluation points used.

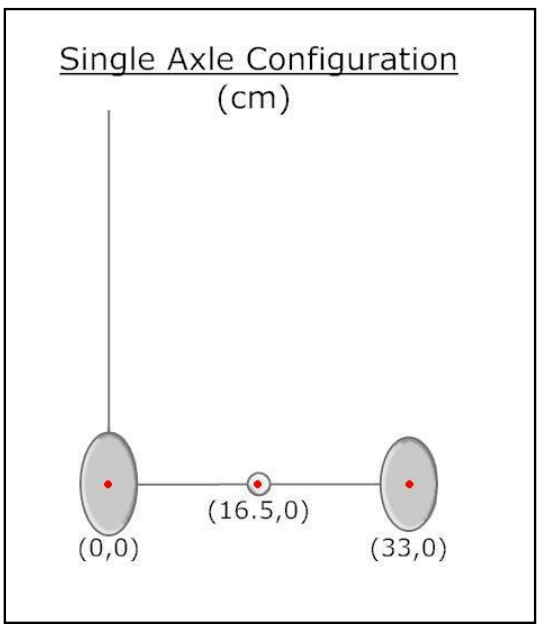


Figure 7-8 Single Axle Configuration

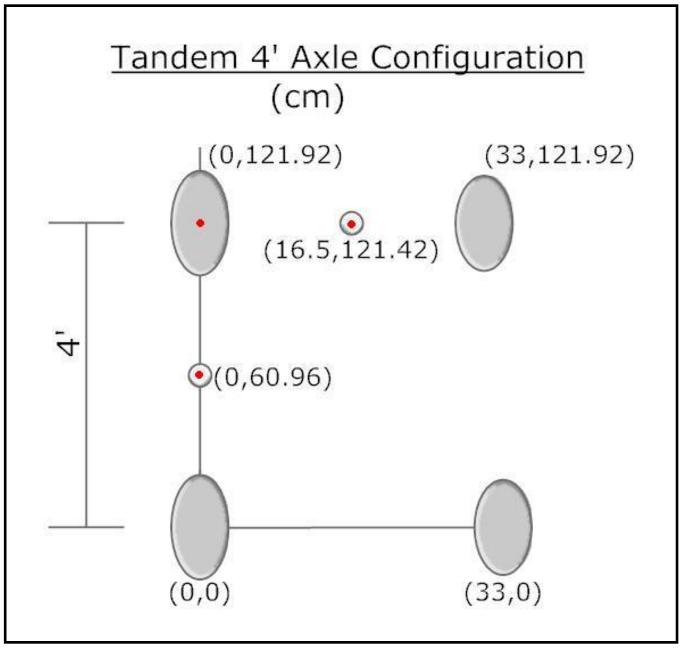


Figure 7-9 Tandem Axle Configuration Spaced at 4’

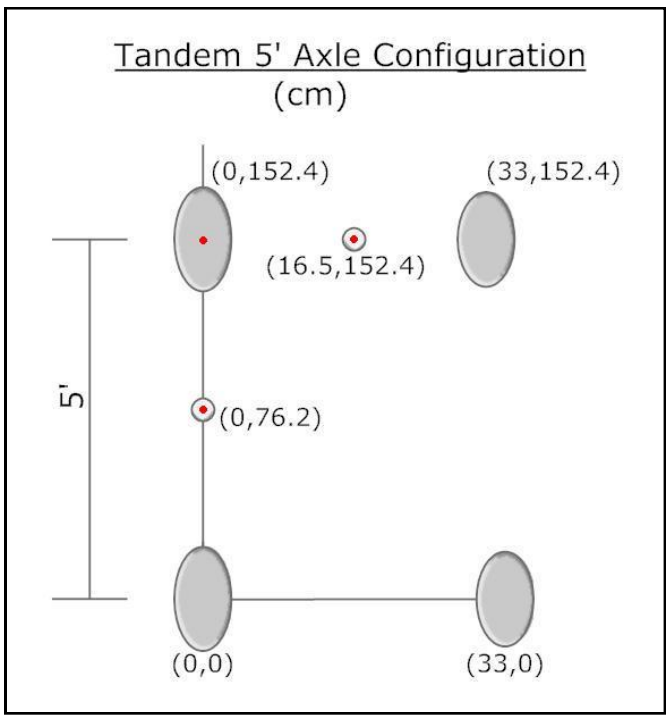


Figure 7-10 Tandem Axle Configuration Spaced at 5

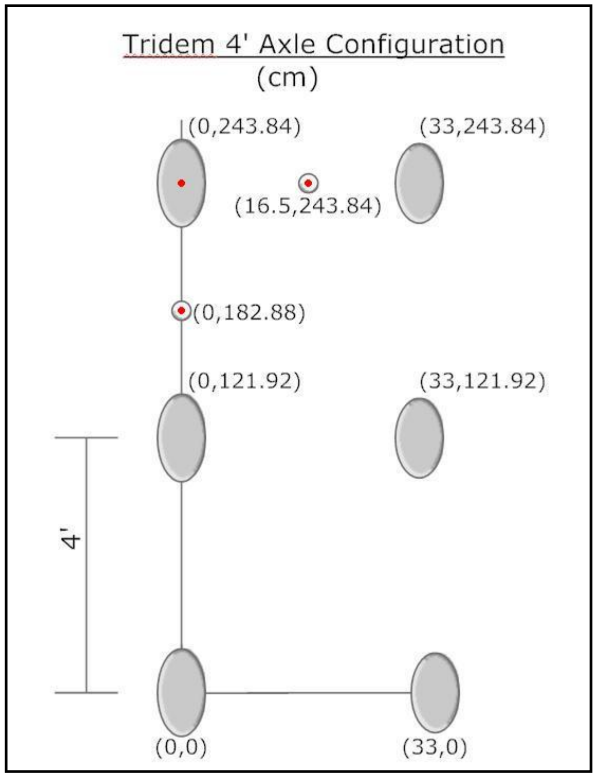


Figure 7-11 Tridem Axle Configuration Spaced at 4'

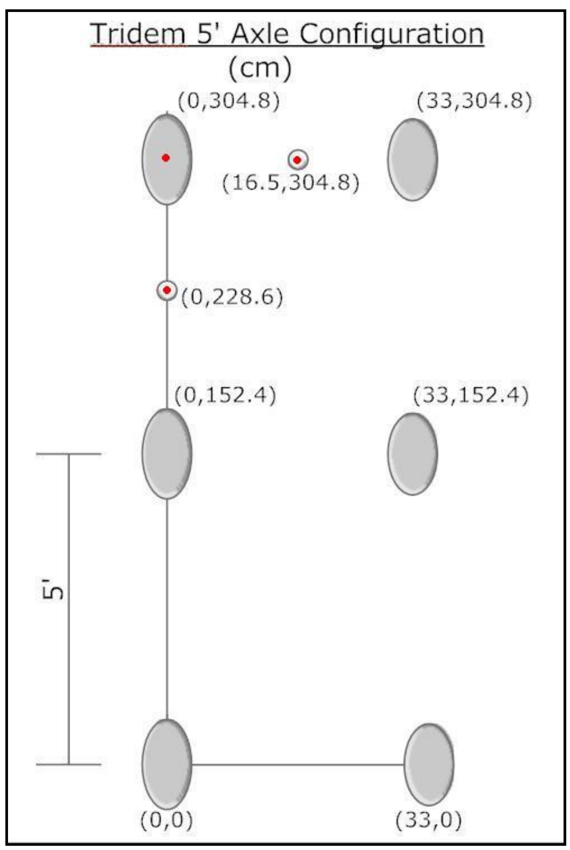


Figure 7-12 Tridem Axle Configuration Spaced at 5'

Loading

Loading was assumed to be the same on each wheel for all configurations. The minimum amount per tire used was 500 lbs and the maximum amount per tire was 4500 lbs. The values were converted to Newtons, N for entry into EverStress as sown in Table 7-30.

Table 7-30 Loading Used for Theoretical Analysis in EverStress

Weight per Tire (lbs)	Weight per Tire (kips)	Weight per Tire (N)
500	0.5	2,224
1500	1.5	6,672
2500	2.5	11,120
3500	3.5	15,568
4500	4.5	20,016

The layer information determined for the vehicle classification analysis was still valid and used again. Because the test week is still of interest, the same temperature range and corresponding modulus values was used. To expedite the analysis, sample input files were again created in Excel for each of the axle configurations.

Table 7-31 Single Axle Load and Evaluation Location

Single			
No. Loads	2	No. of x-y Eval. Points	3

Load Information		
x-position (cm)	0	33
y-position (cm)	0	0
Load (N)		
Pressure (kPa)	690	690
Radius (cm)*	-	-

Evaluation Points (cm)			
x-position	0	16.5	33
y-position	0	0	0
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Table 7-32 Tandem 4' Axle Load and Evaluation Location

Tandem - 4'			
No. Loads	4	No. of x-y Eval. Points	3

Load Information				
x-position (cm)	0	33	0	33
y-position (cm)	0	0	121.92	121.92
Load (N)				
Pressure (kPa)	690	690	690	690
Radius (cm)*	-	-	-	-

Evaluation Points (cm)			
x-position	0	0	16.5
y-position	60.96	121.92	121.92
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Table 7-33 Tandem 5' Axle Load and Evaluation Location

Tandem - 5'			
No. Loads	4	No. of x-y Eval. Points	3

Load Information				
x-position (cm)	0	33	0	33
y-position (cm)	0	0	152.4	152.4
Load (N)				
Pressure (kPa)	690	690	690	690
Radius (cm)*	-	-	-	-

Evaluation Points (cm)			
x-position	0	0	16.5
y-position	76.2	152.4	152.4
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Table 7-34 Tridem 4' Axle Load and Evaluation Location

Tridem - 4'			
No. Loads	6	No. of x-y Eval. Points	3

Load Information						
x-position (cm)	0	33	0	33	0	33
y-position (cm)	0	0	121.92	121.92	243.84	243.84
Load (N)						
Pressure (kPa)	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-

Evaluation Points (cm)			
x-position	0	0	16.5
y-position	182.88	243.84	243.84
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Table 7-35 Tridem 5' Axle Load and Evaluation Location

Tandem - 5'						
No. Loads	6		No. of x-y Eval. Points	3		

Load Information						
x-position (cm)	0	33	0	33	0	33
y-position (cm)	0	0	152.4	152.4	304.8	304.8
Load (N)						
Pressure (kPa)	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-

Evaluation Points (cm)			
x-position	0	0	16.5
y-position	228.6	304.8	304.8
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

7.4. Analysis of Output Files for Analysis by Axle Configuration

The data was entered into EverStress and resulted in 50 output files. Each configuration has ten output files, 10 temperatures being analyzed, and there are 5 axle configurations. The summary tables can all be found in Appendix 11.C. However, due to the massive amount of analysis data that was created, the raw EverStress input and out files as well as the Excel output files can be found on a separate CD that accompanies this report.

Analysis of the data revealed that as the temperature increased the tensile strain increased at any loading in both the transverse and longitudinal directions. A graphical representation of this conclusion is found in Figure 7-13 and Figure 7-14. Further investigation of the other axle configurations revealed the same trend.

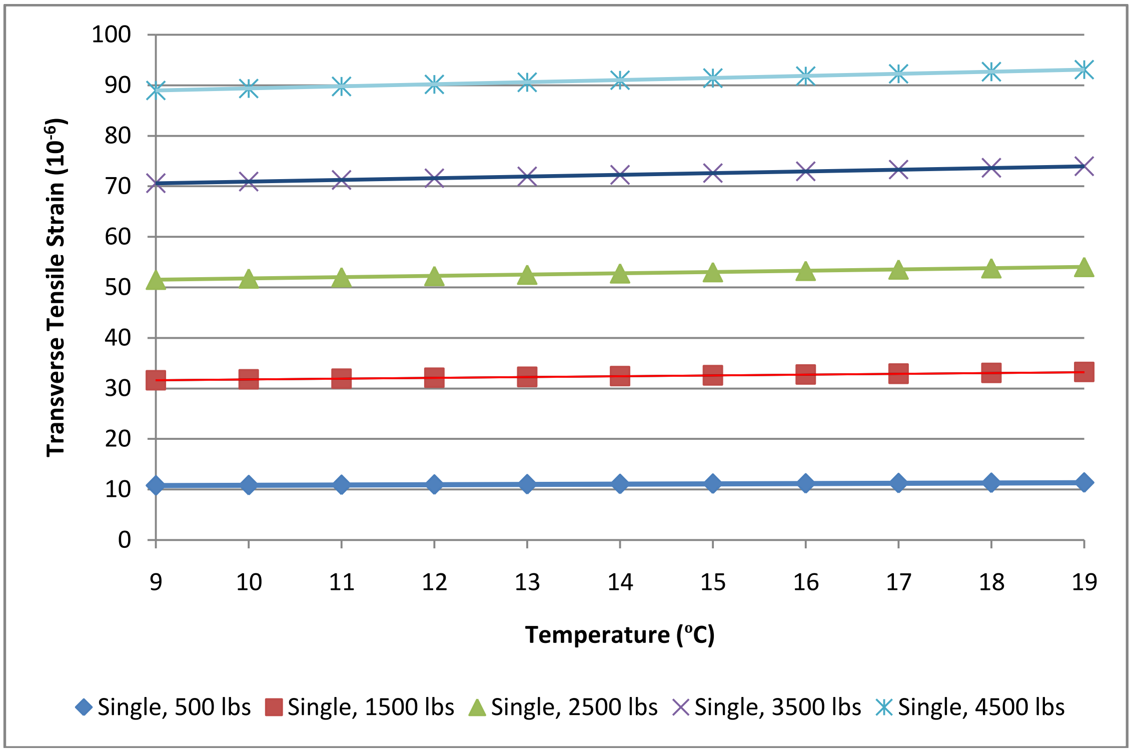


Figure 7-13 Tensile Strains in the Transverse Direction as They Vary With Temperature

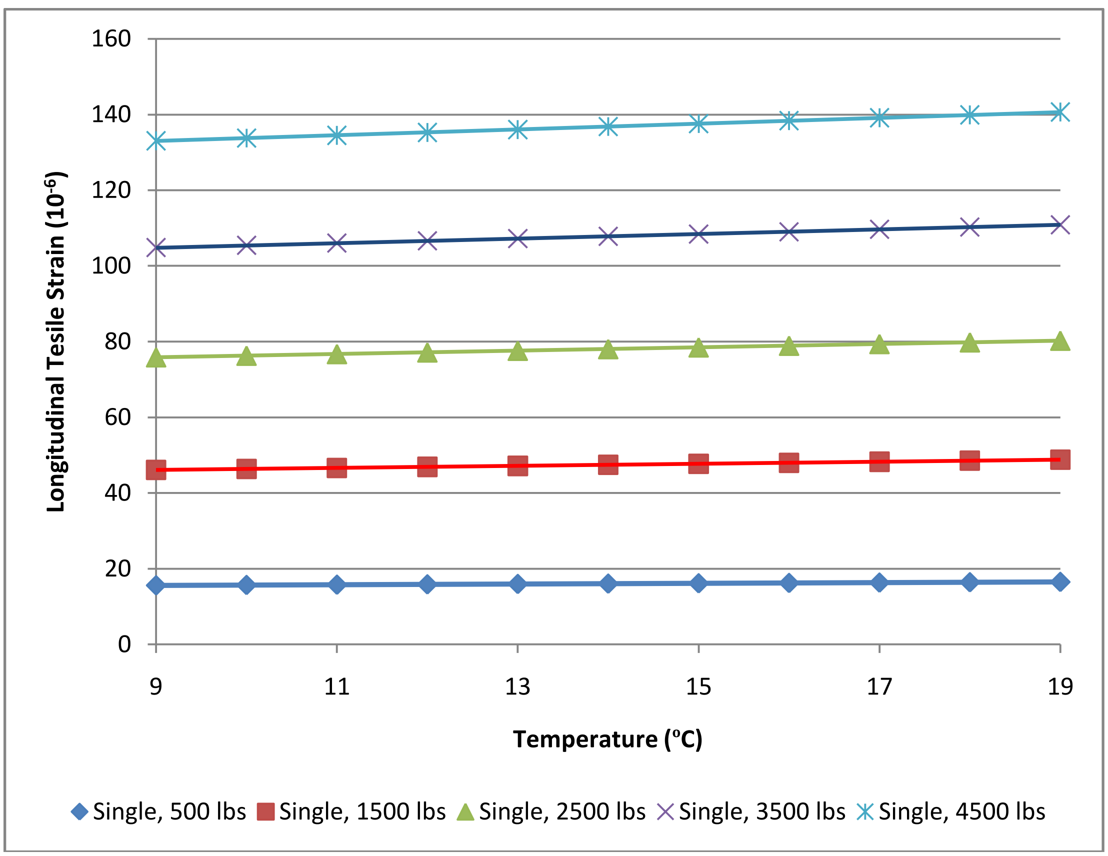


Figure 7-14 Tensile Strains in the Longitudinal Direction as They Vary With Temperature

Another investigation of the data revealed that the tridem at 4’spacing has the largest difference in tensile strain in the transverse direction to the single axle, but in the longitudinal direction the opposite was true, it was having the most similar values of strain. It also revealed that tandem at 500 lbs has exactly the opposite at the tridem at 4’ spacing. As it can easily be seen, in general, the direction that the tensile strain is measured can be completely opposite in magnitude.

Figure 7-15 and Figure 7-16 go further to reveal a curious difference between transverse and longitudinal strains. In the transverse direction, all of the curves are decreasing steadily. This means that as the temperature increased, the strain response magnitude of increase slowed down. However, in the longitudinal direction there was no consistent trend. Both the tandem spaced at 5’ and the tridem spaced at 4’ have almost steady slopes which means their strain increased with the same magnitude that the single axle did with an increase in temperature. The offset was due to the fact that overall they reacted with a higher magnitude of tensile response and increase in strain response at the same rate. Next, the tandem at 4’ spacing reacted the same in both directions. The higher the temperature went the slower the strain response. The opposite was true for the tridem at 5’ spacing. The higher the temperature got the quicker the strain response increased.

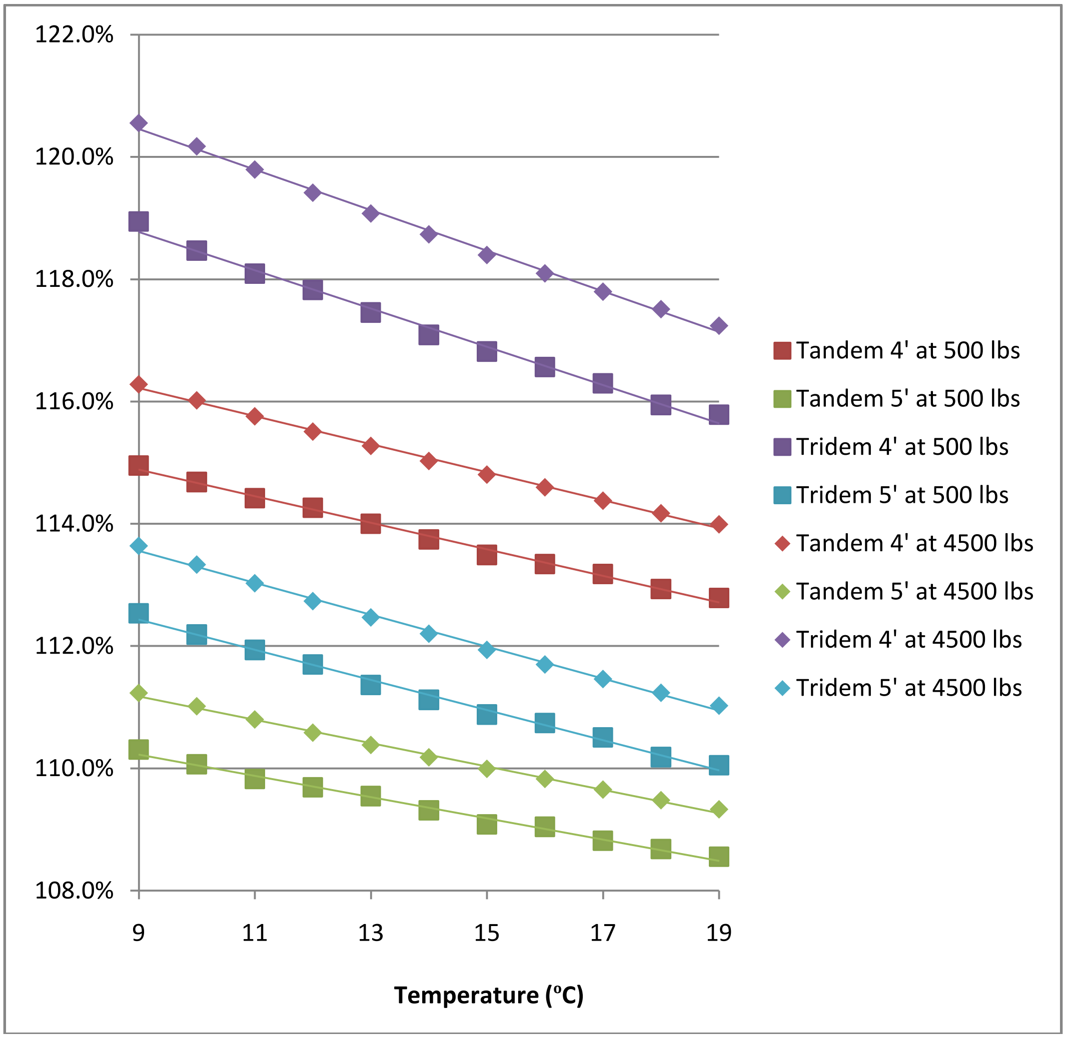


Figure 7-15 Maximum Single Transverse Tensile Strain

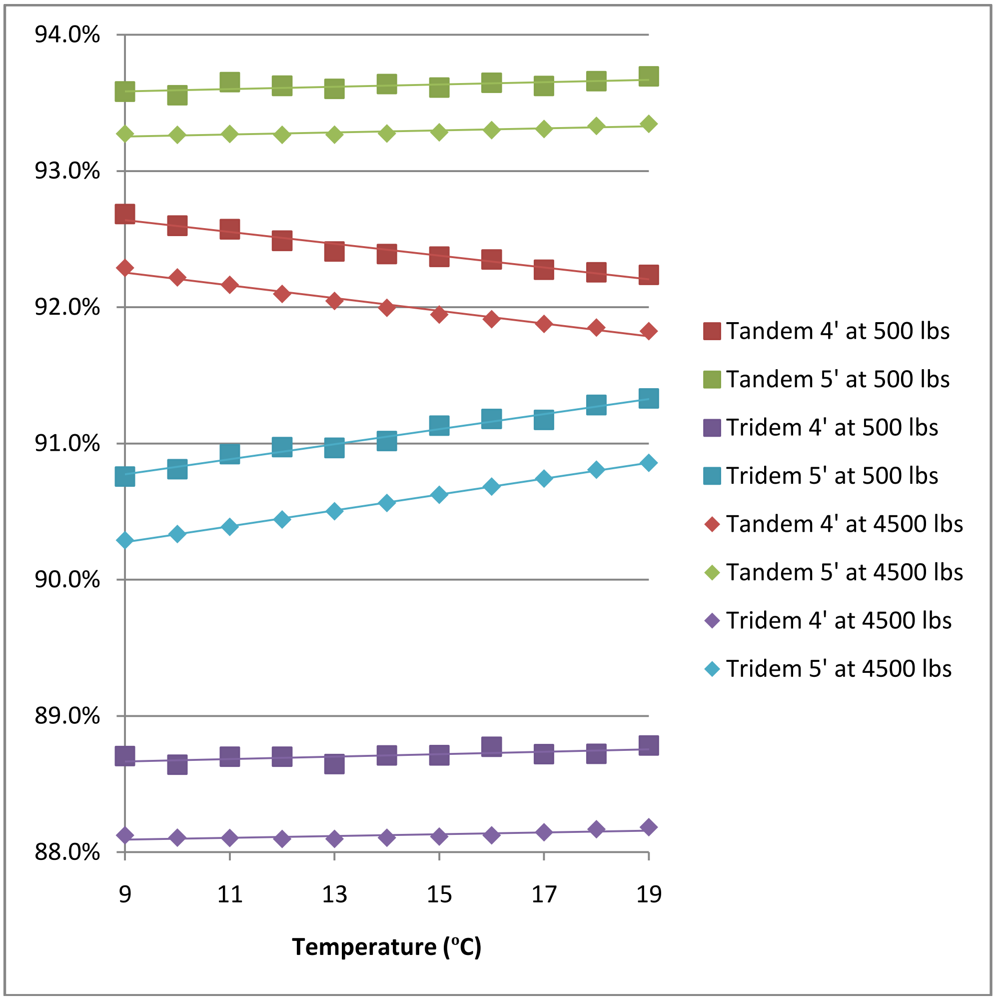


Figure 7-16 Percent of Maximum Single Longitudinal Tensile Strain

7.5. In-Place Strain Data Analysis for January

The output from the in-place strain gages is a very large file with approximately 20,000 lines of data for each event. A data reading is taken every .001 seconds for a period of approximately 20 seconds. Before looking at the data it was thought that a plot of strain vs. time would reveal a curve which was consistently flat, followed by a rise and then another flat period, representing a vehicle driving over the sensors. However this did not seem to be the case. The data for each vehicle varied slightly under each vehicle, but with no clear pattern. The best reason for this errant data could be because of malfunction on part of the sensors, or the very stiff pavement, resulting in very small strains. Of the 12 sensors, only 4-5 for each event actually recorded data that varied. These 4 sensors were consistently 2, 4, 6 and 7 with sensor 11 recording varying data in most of the selected events.

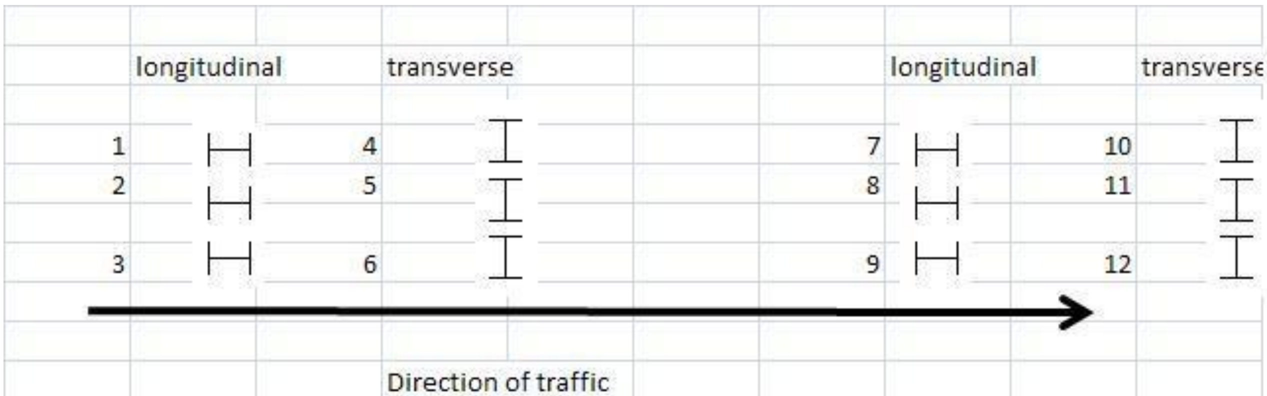


Figure 7-17 Layout of Strain Gages

The selected events were analyzed and also compared to the given temperature recorded by the thermocouples at the time to the closest hour. (Thermocouple data is recorded hourly.) For the date of January 25, 2008 the +temperatures in the asphalt layers recorded by the thermocouples in place were as follows:

Table 7-36 Layer Temperature Data for January 25, 2008

AVG	AVG	AVG
Layer 1	Layer 2	Layer 3
-4.98445	-4.6123	-5.36115

These temperatures are recorded in degrees Celsius.

The following graph shows data from the selected date for the first period when the sensor was triggered.

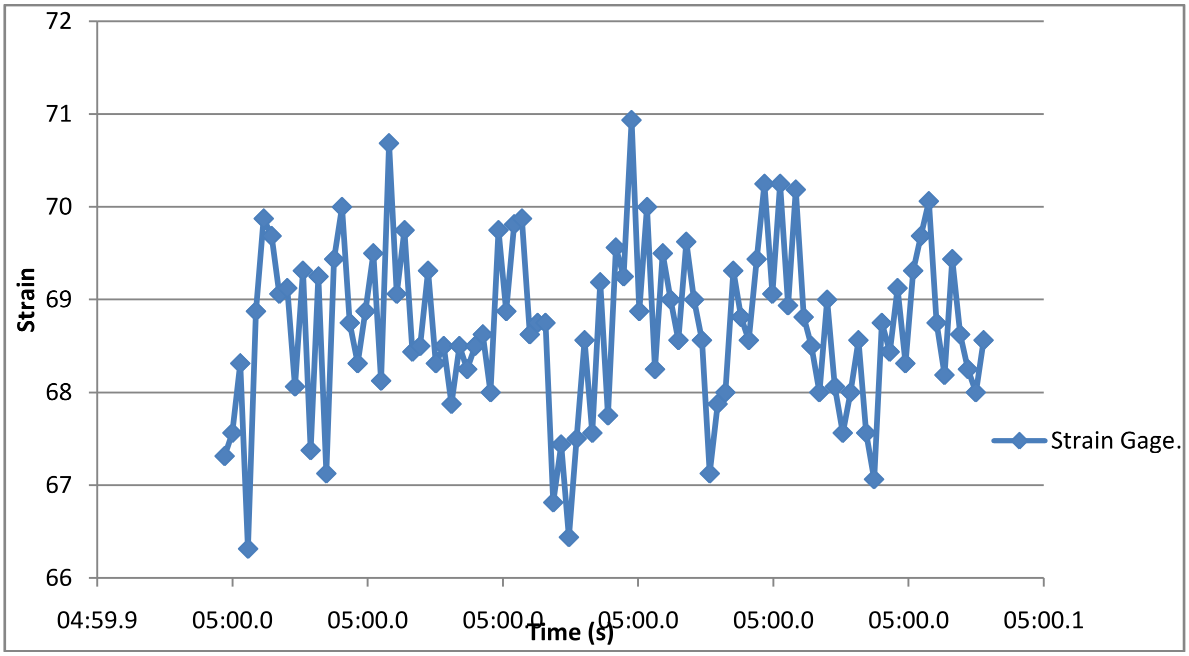


Figure 7-18: Strain Gage 2 1/25/08 5 pm Strain Versus Time

The period of this graph is only one tenth of a second. When looking at the graph over a longer period of time the data stays within in the same range. This shows that the strains did not accurately represent what was thought to occur. When expanding the graph over a longer time period, 2.5 seconds the results are similar. When comparing the two charts it can be seen that the range of data is very similar. The data ranges between roughly 66.5 and 71 on both graphs. The graph with a longer period has a few points that are outside of this range, but seem to be abnormalities rather than results in a great increase in strain due to the load of a vehicle. When sorting the data of strain gage two on the day, it reveals that the actual variation of the data ranges from 63.9423 to 72.3085. This data is spread almost evenly throughout the entire time range. This suggests that although the strain did vary, the variation almost appears random, rather than the result of changes in the loading on the pavement. This data would be shown by graph or by the data tables; however there are too many data points to logically display this. This is why data has been selected from a very small time frame. In all events that were examined, the data from gages 4 and 11 was recorded as a negative. For the date of January 25, 2008 the temperatures in the asphalt layers were as follows:

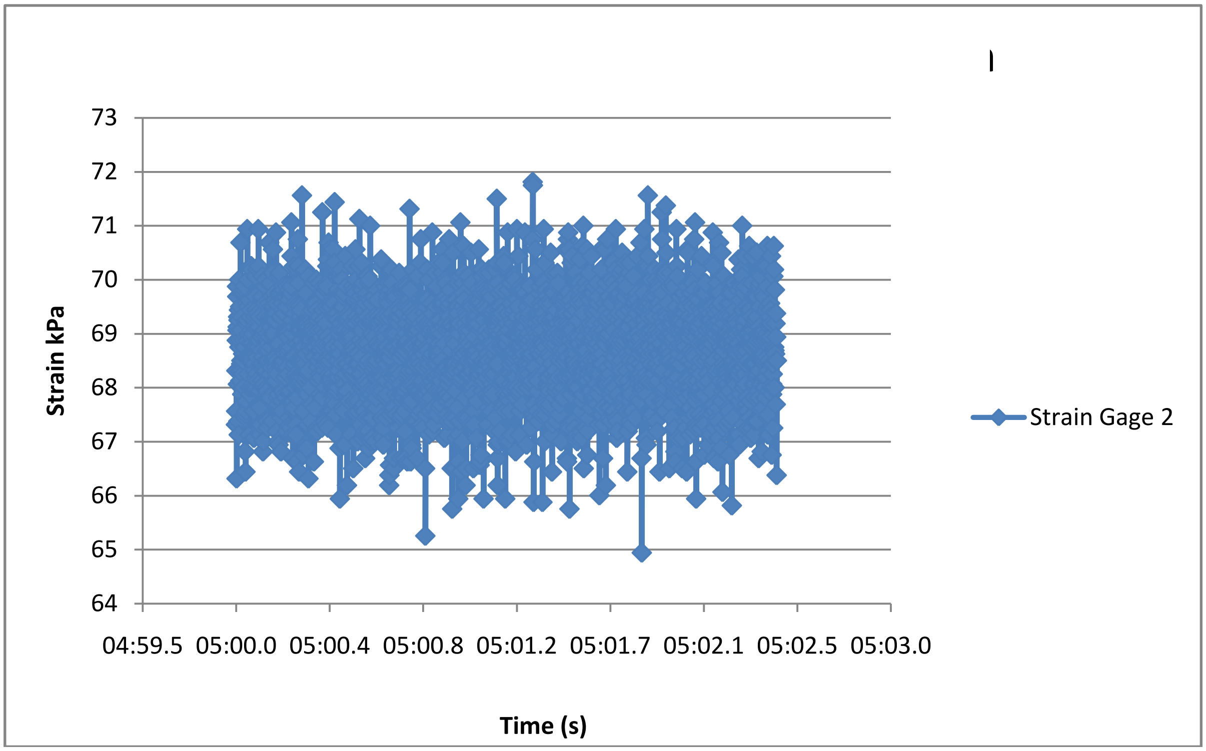


Figure 7-19: Strain Gage 2 1/25/08 5:05.0-5:05.3 pm

One reason why the strains recorded do not allow for any conclusions could be due to the cold pavement temperatures. The pavement temperatures were below freezing for all layers. This could make the sensors malfunction due to the pavement being too rigid under the freezing conditions to allow for any real results to be recorded, or the pavement could be so stiff as to cause a very small amount of strain under traffic. For the period of time that both the thermocouple data and the strain gage data overlap the temperature in the asphalt layers is below freezing or right at the freezing mark.

The following graph displays the data obtained from strain gage 2 on 1/29/08 at 6pm. This data is similar to that recorded on 1/25/08 in range, except the values are significantly lower in this case. The values for this entire event range from 9.878 to 21.2397. The temperatures for the event displayed below were:

Table 7-37 Layer Temperature Data on January 29, 2008

Layer 1	Layer 2	Layer 3
-0.89857	0.243925	0.71878

The temperatures in the pavement were slightly higher than on the 25th of January and the resulting strains appear to be lower.

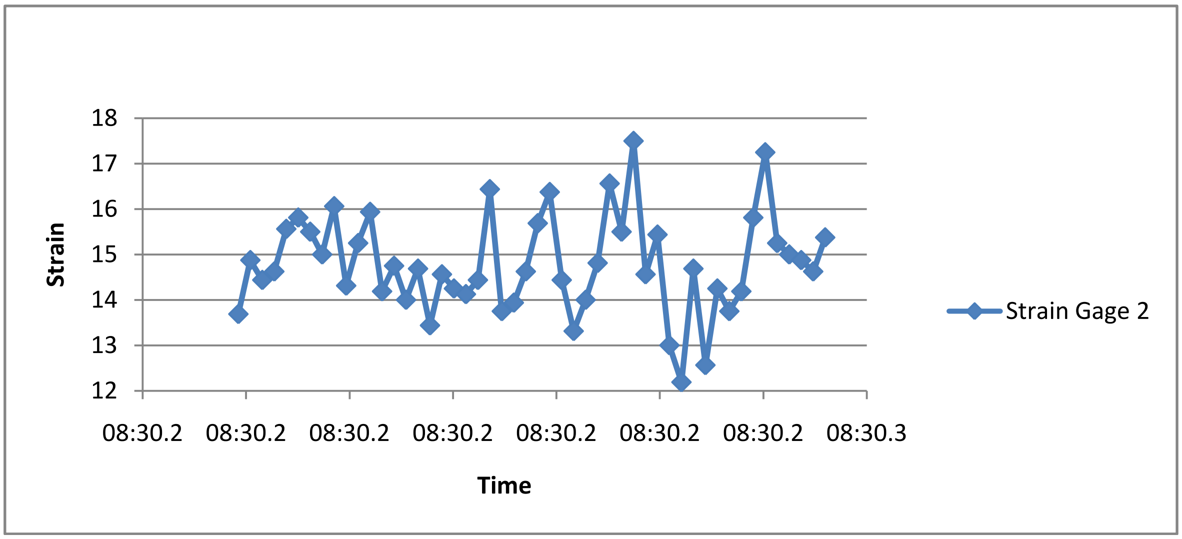


Figure 7-20: Strain Gage 2 1/29/08 6pm

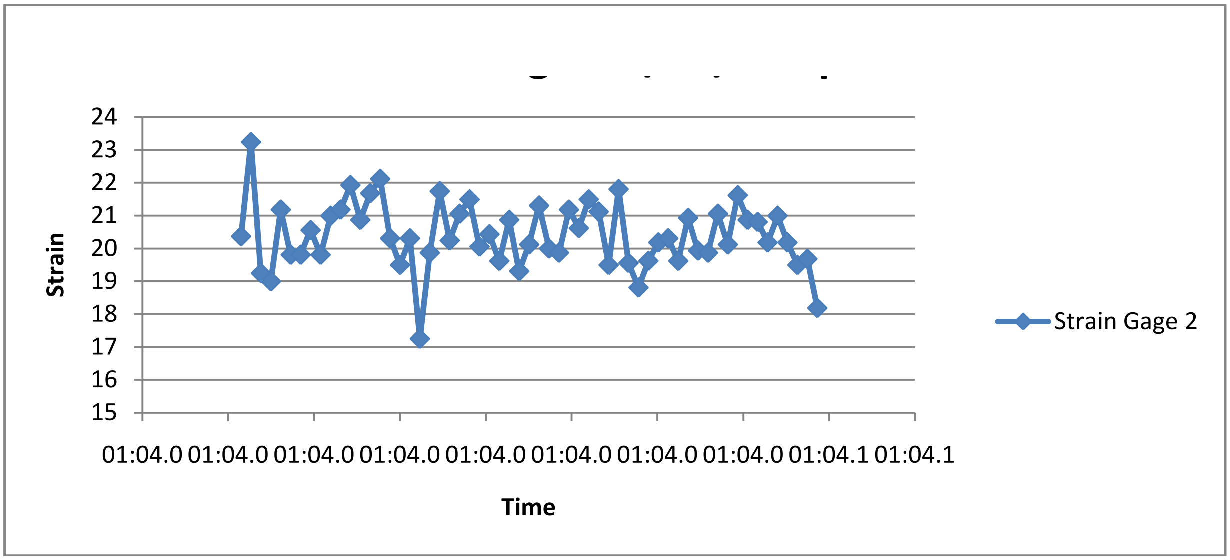


Figure 7-21:Strain Gage2 1/6/08 4pm

The above graph is strain gage 2 data from 1/26/08 at 4 pm. Again the data shows no clear pattern, rather fluctuating between a certain ranges. The asphalt temperatures at this time were as follows:

Table 7-38 Layer Temperature Data on January 26, 2008 Gauge 2

Layer 1	Layer 2	Layer 3
-2.7509	-1.5605	-1.43335

These temperatures are between the previous two selected dates and the strains are also between the two. This follows the understood property that with higher temperatures the strains should be higher in pavement. Higher temperatures result in a less stiff pavement and hence relatively higher deflection under the same load.. In should be taken into account that in this project “high temperatures” refer to those slightly above freezing. In order to truly see the effects of traffic, traffic and response data would have to be collected from a variety of seasons.

7.6. Analysis by Axle Configuration for January Using January Thermocouple Data

The analysis conducted for our test week was repeated for the data collected in January so that we could directly compare the strain data collected by the strain gauges. The procedure of this analysis is outlined below

Traffic Data

The first step was to determine which type of axle configuration to analyze. Therefore, the traffic data was sorted and counted to determine which classes of vehicles had the top three volumes of travel. As seen in Figure 7-22 below, class 2 and class 3 have the highest volume. However, they are made up of only steer axles with very low loading, so have much less impact on the road than class 4 and higher, and therefore were omitted for making this decision. It was instead found that Class 10 has the largest volume with 4,746 and is made up of one tandem, and one tridem axel. Class 5 with 2,921 vehicles had the second most, and has only one single axle. Class 4 would be the third highest with 892 vehicles and it has only one single axle. Since the top three classes contain single, tandem and tridem axles, they were used in the subsequent analysis. Specifically, the tandem and tridem at 4 foot spacing configurations were modeled because they have a greater effect compared to the 5 foot spacing. Lastly, these configurations were analyzed at 4500 pounds per tire, again to get the highest strain values.

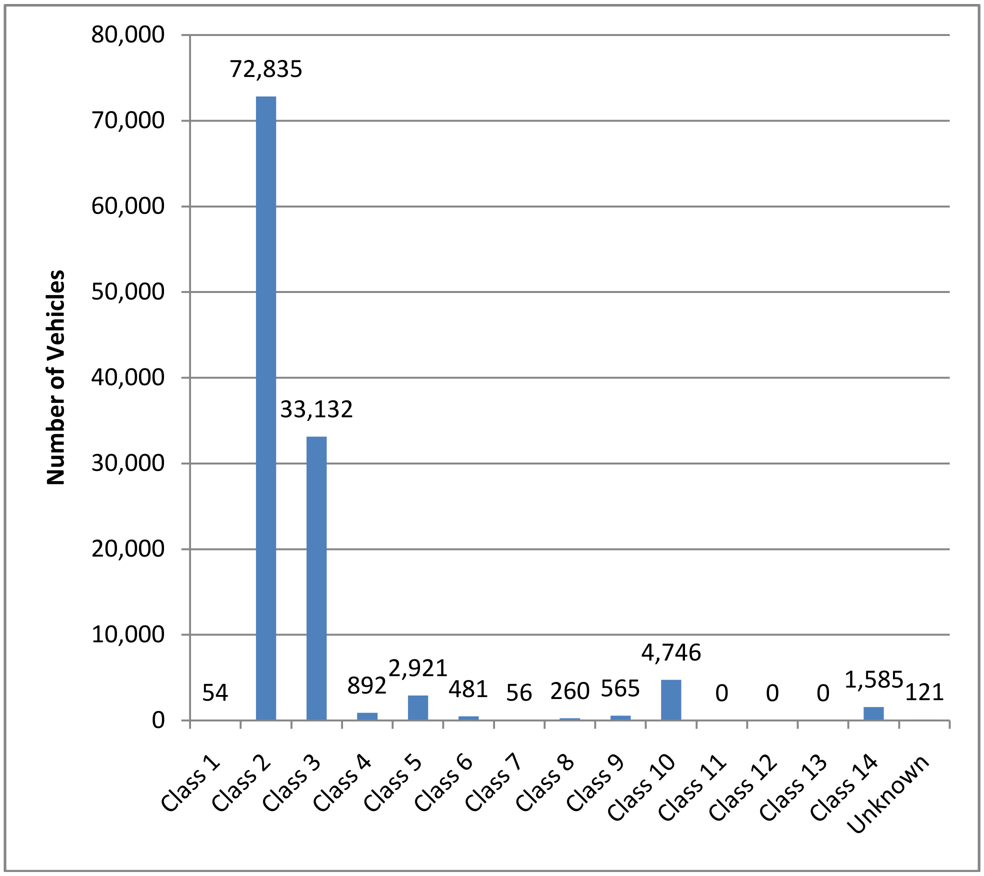


Figure 7-22 January Traffic Data

January Thermocouple Data and Modulus Values

The next step is to determine for what temperature values to analyze at by using the thermocouple data from January. This data is from January 16, 2008 to January, 31 2008. By plotting this data, as shown in Figure 7-23, there can be seen a slight warming trend occurring throughout the month. Because there is such an increase in temperature it was decided to investigate the strains at the lowest, highest and mean temperatures to get a better idea of how the strains varied during this time period. The temperatures are shown in Table 7-39 . With these temperatures the resilient modulus for the first layer were determined for each temperature using the regression equation previously created, as shown in Table 7-40.

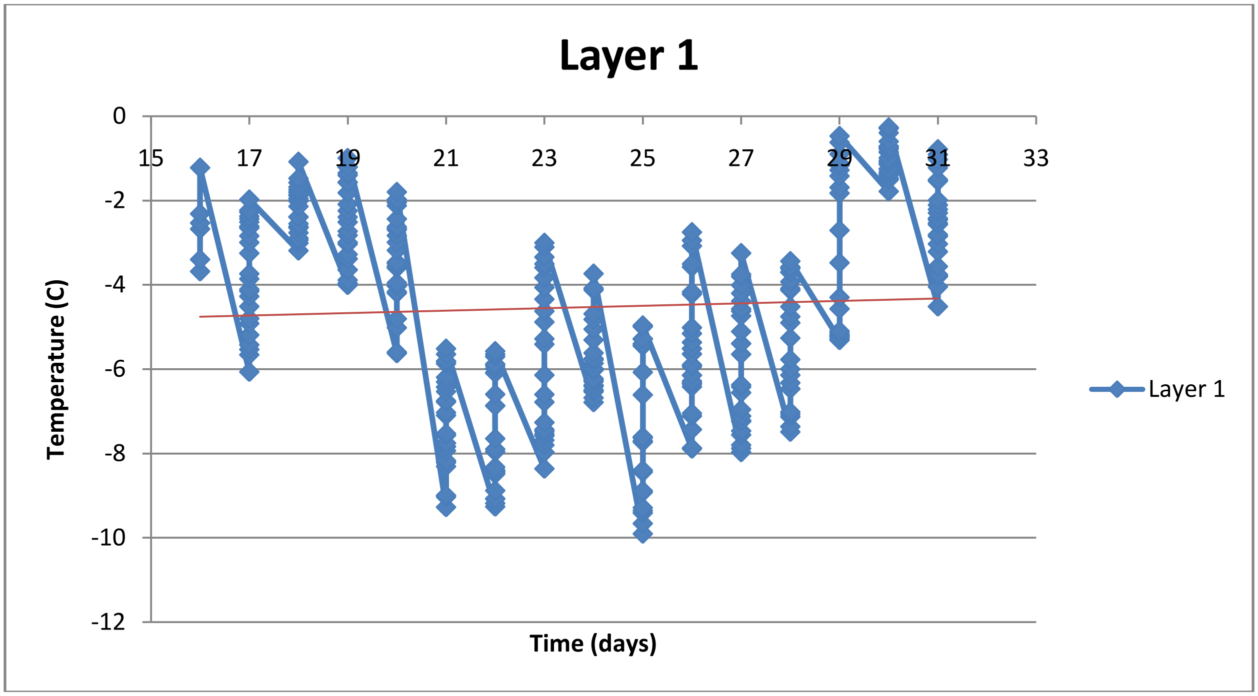


Figure 7-23 January Thermocouple Data

Table 7-39 January Temperature Data

January Thermocouple Data		
High	Low	Mean
-0.26746	-9.90145	-4.530076
1/31/2008	1/25/2008	

Table 7-40 January Modulus Values

	January 16th to 31st	
	Temperature (°C)	Mr (MPa)
high	-0.27	14,026
low	-9.90	34,815
mean	-4.53	20,972

Now that all the information is gathered, the EverStress analysis can be performed with the same procedure performed in section 7.3 and section 7.4. Please refer to this section for a detailed outline. It was found that the single axle in the longitudinal direction has the highest values of tensile strain, as shown in Figure 4-2. Not unsurprisingly the single axle in the transverse direction has the lowest values of tensile strain. This trend was already discovered in the analysis by axle configurations.

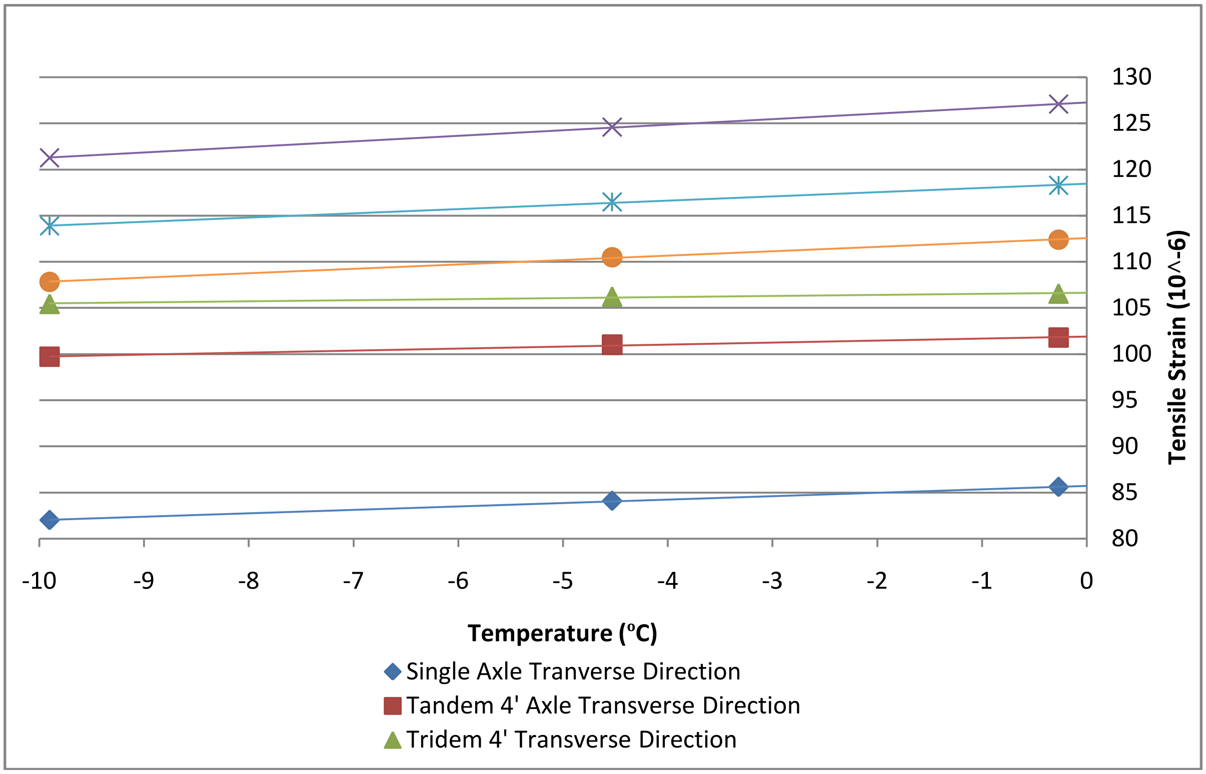


Figure 7-24 Tensile Strain Comparison at 4500 lbs per Tire

Additionally, the tridem at 4 foot spacing in the transverse direction had the highest difference in strain when compared to the single axel in the same direction. As shown in Figure 7-24. Again the same trend shown the first set of analysis for axle configuration, the tridem at 4 foot spacing had the least strain difference to the single axle in the longitudinal direction.

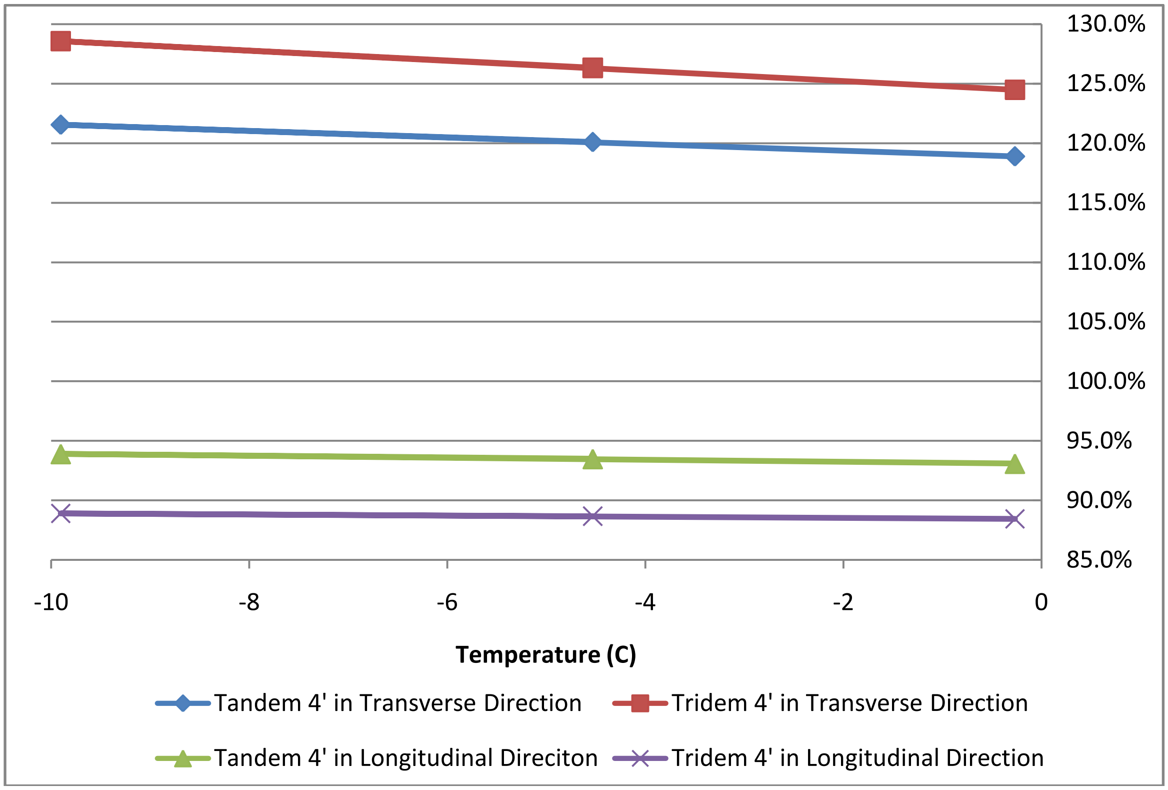


Figure 7-25 Comparison of Percentage of Maximum Single Transverse and Longitudinal Tensile Strain For 4500 Pounds Per Tire

7.7. Effect of Higher Loading on Pavement Life

The last analysis related to the question about how the pavement life span was affected from an expected increase in loading. The scenario considered was how much short would the pavement last if the loading were to be increased by 5% for only one month out of the year. The one month was assumed to be in the spring and since a temperature of 9ºC already analyzed, which is close to the average temperature for a spring month, the data from that temperature was chosen. The configurations to be investigated were the single axle and, tandem at 4’ spacing and tridem at 4’ spacing. Four feet spacing was assumed, again, to use the most conservative scenario. The data required was summarized into Table 7-41. The maximum value occurred in the longitudinal direction for all tensile strain values recorded.

Table 7-41 Maximum Strains at 9C Under The Specified Loading Conditions

Load On Each Tire (lbs)	Maximum Strain In The Longidudinal Direction Under (10^{-6}) Single	Tandem 4'	Tridem 4'
500	16.49	15.21	14.64
1500	48.8	44.96	43.25
2500	80.25	73.86	71.01
3500	110.85	101.91	97.92
4500	140.64	129.14	124.02

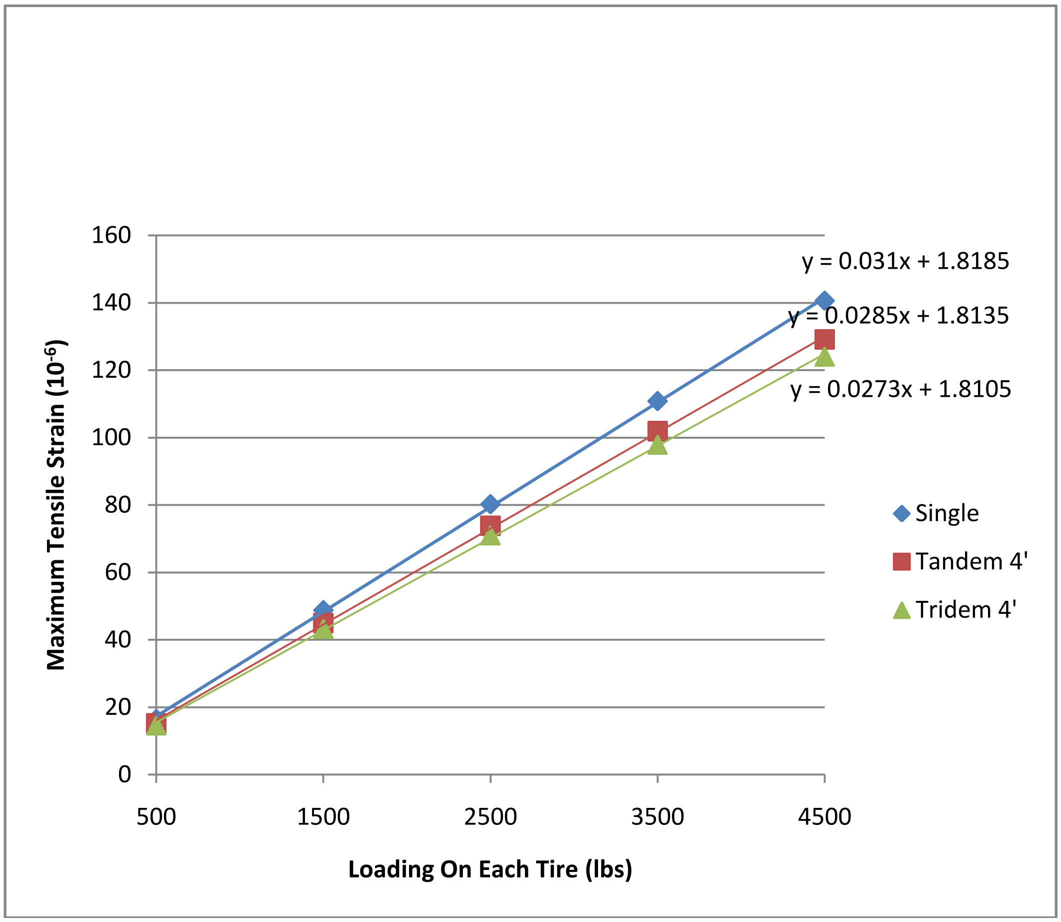


Figure 7-26 Relationship Between Maximum Tensile Strain and Loading Per Tire For Different Loading Configurations at 9ºC

Linear regression equations were found for each axle configuration by graphing the data in Table 7-41. As it can be seen in Figure 7-26, the single axle has a greater maximum tensile strain but they all have similar slopes. These equations were used to determine what tensile strain value would result from a 5% increase in the base loading condition of 4500 lbs. The estimated pavement life was then determined using the equation,

$$N_f = 1.0x10^{12}\varepsilon^{-2.7031},\ R^2 = 0.8624, \quad \text{(for longitudinal strain gauges).}$$

This equation was from a study conducted at Worcester Polytechnic Institute to determine the life cycle cost of HMA pavement at different thickness[80]. This specific equation was derived to relate failure load with strain response. In other words, it tells you how many repetitions at specified strain value that a pavement can endure before failure. As it can be seen in Table 7-42, it can be expected that for at 5% increase in loading for one month out of a year will decrease the pavement life by approximately 1%.

To be conservative, 4500 lbs per tire was chosen as the base loading condition.

Table 7-42 Relationship Between Tensile Strain and Pavement Life

	Load (lbs)	Strain at 9ºC (10^{-6})	Percent Increase In Strain Due to 5% Increase In Loading	Pavement Life Under Given Loading	Pavement Life For 5% Increase In Loading For One Month of The Year	Percent Change in Pavement Life
Single	4500	141.3	4.936%	1,540,980.1	1,525,927.24	-0.977%
	4725	148.3		1,352,819.4		
Tandem 4'	4500	130.1	4.930%	1,928,530.2	1,909,710.34	-0.976%
	4725	136.5		1,693,282.2		
Tridem 4'	4500	124.0	4.955%	2,196,331.8	2,174,798.69	-0.980%
	4725	130.1		1,927,168.1		

8. Pavement Design Using MEPDG Design Software

The Mechanistic-Empirical Pavement Design (MEPD) software was used to design a pavement section in the location of the instrumented test section in Maine with the consideration of appropriate traffic and environmental conditions. The program was created by the National Cooperative Highway Research Program (NCHRP) to better fit the changes made in pavement design with the release in 1986 of the AASHTO Guide for Design of Pavement Structures. Previous version of pavement design guides only used empirical data. The new MEPD Guide/software incorporates both mechanistic and empirical data to test a pavement structure. The program calculates the appropriate material properties (such as stiffness) for every minute of every day for as many years you design for and determines a damage number. At the end of the design years, if the sum of the damage numbers is greater than 1, the pavement structure fails. There are also design standards that can be put in to test the structure against. This program was a vital tool in our designing process.

The MEPDG had built in average data in the programs, but they gave the option to change any value to the site specific conditions. Our design is developed with a 20 year design life for the pavement. The three main categories where we entered data were traffic, environmental and the actual pavement structure. The traffic data consisted of vehicle class distributions, between classes 4 and 13. For this project, we used a linear traffic growth rate of 4%. There was no environmental data in the program for Guilford, ME, so the program was used to predict the climate data by interpolating data from three nearby weather stations of Millinocket, ME, Bangor, ME and Houlton ME. Lastly, our design consists of 3 layers in the structure. There is 3 inches of HMA with PG 64-28 asphalt binder, 6 inches of crushed gravel and subgrade of A-5 material.   All of the inputs for our design can be seen in Appendix 11.F.

The design process started with inputting all the traffic and environmental data with the current pavement structure into the MEPDG. The current road conditions failed after the program ran the analysis. It was determined that the structure was failing due to top layer rutting. Figuring this out gave us a starting point for what to change in the design, with the asphalt. The original design had 3 layers of asphalt with a total thickness of 10.7 inches. With such thick asphalt, the chances of it consolidating and causing rutting due to repetitive loads increases, especially with heavy logging trucks associated with Maine. The final design can be seen below in Figure 8-1. The new design reduces the asphalt to only one layer, 3 inches think. From here the design was run multiple times to find the minimal thickness of crushed gravel needed to support the structure. A thickness of 6 inches of crushed gravel and a subgrade material of A-5 were selected for the final design.

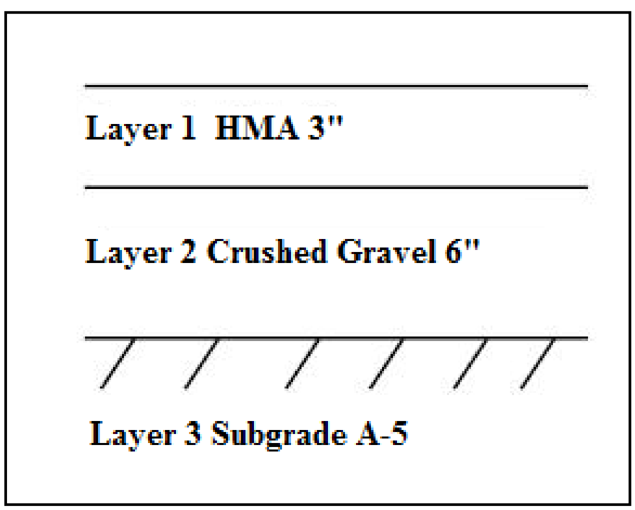


Figure 8-1 New Pavement Structure

As a final analysis of pavement design, the relationship to pavement cost and design life of the pavement was examined. Our new pavement structure had the optimum layer thicknesses for a 20 year design life. In practice, using a thicker pavement will increase the life of the pavement. However, increasing the pavement thickness costs more. As seen in Table 8-1, as the thicknesses of the asphalt and crushed gravel layers increase, the cost of the pavement greatly increases. This proves that the more money that is put into a project, the longer the road will last. Table 8-1 shows the cost per lane mile for each option.

Table 8-1 Pavement Cost Analysis

	Asphalt Thickness (in)	Gravel Thickness (in)	Cost
New Design	3	6	$152,446.65
Option 1	5	10	$254,077.75
Option2	10	20	$508,155.50
Option 3	15	30	$762,233.25

9. Conclusions

Comparing the environmental and traffic loading data helped us understand the patterns of traffic on our test site. The environmental data showed us that the pavement got colder further down into the structure. The WIM data showed us that there was less traffic during the winter but still a decent amount of truck traffic. Combining both of the data allowed us to determine the heaviest day of traffic to be Thursday and that it was one of the colder days of the week we had analyzed.

Analysis for each classification resulted in only an incomplete analysis for a class 6 vehicle because of the unreliability of the WIM data at grouping the data correctly by class. The analysis which was computed, the maximum transverse strain occurs at the driver's side back tire, 114.04 micro strains, and the maximum longitudinal strain occurs at the midpoint of the driver's side back tandem tires, 171.7 micro strains. In addition, the longitudinal direction resulted in higher tensile strains than the transverse direction, from 34% higher at 9ºC and 34% higher at 14ºC.

Analysis of the axle configurations revealed that as the temperature increased the tensile strain increased for all loading conditions in both the transverse and longitudinal directions. Another investigation of the data revealed that the tridem at 4'spacing has the largest difference in tensile strain in the transverse direction to the single axle, but in the longitudinal direction the opposite was true, it was having the most similar values of strain to the single axle configuration. It also revealed that tandem at 500 lbs has exactly the opposite at the tridem at 4' spacing.

There is also a curious difference between transverse and longitudinal strains. In the transverse direction, all of the curves are decreasing steadily. This means that as the temperature increased, the strain response magnitude of increase slowed down. However, in the longitudinal direction there was no consistent trend. Both the tandem spaced at 5’ and the tridem spaced at 4’ have almost steady slopes which means their strain increased with the same magnitude that the single axle did with an increase in temperature. The offset was due to the fact that overall they reacted with a higher magnitude of tensile response and increase in strain response at the same rate. Next, the tandem at 4’ spacing reacted the same in both directions. The higher the temperature went the slower the strain response. The opposite was true for the tridem at 5’ spacing. The higher the temperature got the quicker the strain response increased.

The last set of analysis was to determine how the pavement life span was affected from an expected increase in loading. The scenario considered was how much short would the pavement last if the loading were to be increased by 5% for only one month out of the year. It was determined that for a 5% increase in loading for one month out of a year will decrease the pavement life by approximately 1%.

After reviewing the data from the strain gages, it was difficult to tell whether or not the gages in place were recording properly over the selected time periods. The gages did however reinforce some of the findings that were determined using the pavement analysis software. The data showed that strain increases with temperature, as days with different temperatures were compared. The data also was in line with the values that were found in the previous analysis. Without further information though, it was very difficult to determine specifically what effect an individual vehicle of a certain class would have on the strain of the pavement, solely by looking at the data from the in pavement gages. Knowing that the values we found were most likely plausible, the results from the strain analysis can be verified.

10. Recommendations

In order to complete a study that truly examines the strain response in the pavement structure as compared to the theoretical derived strain response, it is necessary to gather data that encompasses at least an entire year of data. This study only used data from the winter months so it is unknown what the pavement responses are for any other time period. Further research could be built upon the initial findings in this report concerning the data that was taken directly from the in situ pavement instrumentation. More investigation needs to be conducted on the strain data that is collected to find and exact correlation between the theoretical strain value and the strain gauge values. For example, further analysis could be conducted to find out what the strain response is at temperatures higher than 19°C. For the temperature range investigated, 9°C to 19°C, it was determined that as the temperature increased the tensile strain increase linearly. It would be valuable to determine if this trend continues to be true at higher temperatures.

11. Appendix

11.A. Resilient Modulus for the Subgrade Calculations

- Calculate Geostatic Stress, see Figure 7-2

$$\sigma_Z = \Sigma\gamma H$$

$$\sigma_Z = 22.8\text{kN/m}^3(0.035\text{m}) + 20.5\text{kN/m}^3(0.04\text{m}) + 19.7\text{kN/m}^3(0.195\text{m}) + 18.9\text{kN/m}^3(0.51\text{m}) + 18.9\text{kN/M}^3(0.152\text{m})$$

$$\sigma_Z = 17.9713\text{kN/m}^2$$

The next steps would have be conducted if it was found necceassy to evaluate the modulus due to a change in traffic loading.

- Calculate Induced Stress

$$\sigma_Z = \frac{3PnZf^3}{2\pi R^5}$$

Where: R= varies due to load placement, see Appendix for calculations *(in future)*

- Calculate Lateral Earth Pressure

$$\sigma_L = k(\sigma_{z,total})$$

where: k is 0.4

- Calculate Bulk Stress

$$(\text{kPa})\ \Theta(\text{Bulk}) = 3\sigma_L + (\sigma_{z,total} - \sigma_L)$$

- Calculate Mr (Mpa) for subgrade layer
  - Equation for soil at Hancock Maine, location closest to Guilford[81]

$$(\text{MPa})\ Mr = -109.239 + 30.434 \ln(\Theta)$$

Subbase Modulus Determination: EverStress Output File which determined that traffic loading did not created added stresses in the subgrade layer.

CLayered Elastic Analysis by EverStress for Windows								
Line								
Title: Subgrade Mr Investigation								
No of Layers: 5	No of Loads: 5	No of X-Y Evaluation Points: 6						
Layer	Poisson's	Thickness	Moduli(1)					
*	Ratio	(cm)	(MPa)					
1	0.35	3.5	2000					
2	0.4	4	2000					
3	0.4	19.5	2000					
4	0.4	51	150					
5	0.4	*	20					
Load No	X-Position	Y-Position	Load	Pressure	Radius			
*	(cm)	(cm)	(N)	(kPa)	(cm)			
1	0	0	311	690	1.198			
2	32.92	0	311	690	1.198			
3	0	777.24	304	690	1.184			
4	32.92	777.24	304	690	1.184			
5	0	1291.2	329	690	1.232			
Line								
Line								

Location No: 1	X-Position (cm): .000	Y-Position (cm): .000						
Line								
Normal Stresses								
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy	
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	
3.499	1	3.02	2.62	-105.66	0	0.21	0	
5.5	2	-2.45	-2.67	-46.98	0	0.32	0	
17.25	3	1.03	1.41	-3.98	0	0.56	0	
52.5	4	0.16	0.18	-0.24	0	0.07	0	
78.001	5	0	0	0	0	0	0	
Line								
Strains and Deflections								
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz	
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)	
3.499	1	19.54	19.27	-53.82	0.169	0.052	12.927	
5.5	2	8.71	8.55	-22.46	0.131	0.049	12.249	
17.25	3	1.03	1.3	-2.48	-0.059	0.029	11.397	
52.5	4	1.19	1.39	-2.46	-0.208	-0.028	10.349	
78.001	5	0	0	0	0	0	0	
Line								
al Stresses and Strains								
Z-Position	Layer	S1	S2	S3	E1	E2	E3	
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)	
3.499	1	-105.66	2.62	3.02	-53.82	19.27	19.54	
5.5	2	-46.98	-2.67	-2.44	-22.47	8.55	8.71	
17.25	3	-4.04	1.1	1.41	-2.52	1.07	1.3	
52.5	4	-0.25	0.17	0.18	-2.57	1.31	1.39	
78.001	5	0	0	0	0	0	0	
Line								

Line								
Location No: 2	X-Position (cm): 16.460	Y-Position (cm): .000						
Line								
Normal Stresses								
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy	
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	
3.499	1	-4.47	-3.92	0	0	0	0	
5.5	2	-4.96	-3.33	-0.11	0	0	0	
17.25	3	-0.19	1.38	-0.98	0	0	0	
52.5	4	0.17	0.18	-0.25	0	0	0	
78.001	5	0	0	0	0	0	0	
Line								
Strains and Deflections								
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz	
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)	
3.499	1	-1.55	-1.18	1.47	0	0.052	11.384	
5.5	2	-1.79	-0.65	1.6	0	0.049	11.418	
17.25	3	-0.17	0.92	-0.73	0	0.029	11.471	
52.5	4	1.3	1.45	-2.62	0	-0.029	10.465	
78.001	5	0	0	0	0	0	0	
Line								
al Stresses and Strains								
Z-Position	Layer	S1	S2	S3	E1	E2	E3	
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)	
3.499	1	-4.47	-3.92	0	-1.55	-1.18	1.47	
5.5	2	-4.96	-3.33	-0.11	-1.79	-0.65	1.6	
17.25	3	-0.98	-0.19	1.38	-0.73	-0.17	0.92	
52.5	4	-0.25	0.17	0.18	-2.62	1.3	1.45	
78.001	5	0	0	0	0	0	0	
Line								

Line								
Location No: 3	X-Position (cm): .000	Y-Position (cm): 388.670						
Line								
Normal Stresses								
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy	
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	
3.499	1	-0.06	0.16	0	0	0	0	
5.5	2	-0.05	0.14	0	0	0	0	
17.25	3	-0.03	-0.01	0	0	0	0	
52.5	4	0	-0.03	0	0	0	0	
78.001	5	0	0	0	0	0	0	
Line								
Strains and Deflections								
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz	
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)	
3.499	1	-0.06	0.09	-0.02	0.01	0.015	4.969	
5.5	2	-0.05	0.08	-0.02	0.009	0.014	4.969	
17.25	3	-0.01	0	0.01	0.002	0.01	4.968	
52.5	4	0.1	-0.2	0.06	-0.017	-0.004	4.981	
78.001	5	0	0	0	0	0	0	
Line								
al Stresses and Strains								
Z-Position	Layer	S1	S2	S3	E1	E2	E3	
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)	
3.499	1	-0.06	0	0.16	-0.06	-0.02	0.09	
5.5	2	-0.05	0	0.14	-0.05	-0.02	0.08	
17.25	3	-0.03	-0.01	0	-0.01	0	0.01	
52.5	4	-0.03	0	0	-0.2	0.06	0.1	
78.001	5	0	0	0	0	0	0	
Line								

Line								
Location No: 4	X-Position (cm): 16.460	Y-Position (cm): 388.670						
Line								
Normal Stresses								
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy	
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	
3.499	1	-0.06	0.16	0	0	0	0	
5.5	2	-0.05	0.14	0	0	0	0	
17.25	3	-0.03	-0.01	0	0	0	0	
52.5	4	0	-0.03	0	0	0	0	
78.001	5	0	0	0	0	0	0	
Line								
Strains and Deflections								
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz	
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)	
3.499	1	-0.06	0.09	-0.02	0	0.015	4.973	
5.5	2	-0.05	0.08	-0.02	0	0.014	4.973	
17.25	3	-0.01	0	0.01	0	0.01	4.972	
52.5	4	0.1	-0.21	0.06	0	-0.004	4.985	
78.001	5	0	0	0	0	0	0	
Line								
al Stresses and Strains								
Z-Position	Layer	S1	S2	S3	E1	E2	E3	
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)	
3.499	1	-0.06	0	0.16	-0.06	-0.02	0.09	
5.5	2	-0.05	0	0.14	-0.05	-0.02	0.08	
17.25	3	-0.03	-0.01	0	-0.01	0	0.01	
52.5	4	-0.03	0	0	-0.21	0.06	0.1	
78.001	5	0	0	0	0	0	0	
Line								

Line								
Location No: 5	X-Position (cm): .000	Y-Position (cm): 777.240						
Line								
Normal Stresses								
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy	
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	
3.499	1	3.02	2.66	-103.59	0	0.21	0	
5.5	2	-2.38	-2.58	-45.98	0	0.32	0	
17.25	3	1.01	1.38	-3.89	0	0.55	0	
52.5	4	0.15	0.17	-0.23	0	0.07	0	
78.001	5	0	0	0	0	0	0	
Line								
Strains and Deflections								
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz	
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)	
3.499	1	19.17	18.93	-52.79	0.165	-0.001	13.233	
5.5	2	8.52	8.38	-22	0.128	-0.002	12.568	
17.25	3	1.01	1.27	-2.42	-0.057	-0.008	11.735	
52.5	4	1.18	1.33	-2.39	-0.203	-0.027	10.712	
78.001	5	0	0	0	0	0	0	
Line								
al Stresses and Strains								
Z-Position	Layer	S1	S2	S3	E1	E2	E3	
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)	
3.499	1	-103.59	2.66	3.02	-52.79	18.93	19.17	
5.5	2	-45.98	-2.58	-2.38	-22	8.38	8.52	
17.25	3	-3.95	1.07	1.38	-2.47	1.05	1.27	
52.5	4	-0.24	0.16	0.17	-2.5	1.29	1.33	
78.001	5	0	0	0	0	0	0	
Line								

Line								
Location No: 6	X-Position (cm): 16.460	Y-Position (cm): 777.240						
Line								
Normal Stresses								
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy	
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	
3.499	1	-4.37	-3.81	0	0	0	0	
5.5	2	-4.85	-3.24	-0.11	0	0	0	
17.25	3	-0.19	1.35	-0.95	0	0	0	
52.5	4	0.16	0.17	-0.25	0	0	0	
78.001	5	0	0	0	0	0	0	
Line								
Strains and Deflections								
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz	
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)	
3.499	1	-1.52	-1.14	1.43	-0.001	-0.001	11.721	
5.5	2	-1.75	-0.63	1.56	-0.001	-0.002	11.755	
17.25	3	-0.17	0.9	-0.71	0	-0.008	11.806	
52.5	4	1.28	1.39	-2.55	0.002	-0.026	10.825	
78.001	5	0	0	0	0	0	0	
Line								
al Stresses and Strains								
Z-Position	Layer	S1	S2	S3	E1	E2	E3	
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)	
3.499	1	-4.37	-3.81	0	-1.52	-1.14	1.43	
5.5	2	-4.85	-3.24	-0.11	-1.75	-0.63	1.56	
17.25	3	-0.95	-0.19	1.35	-0.71	-0.17	0.9	
52.5	4	-0.25	0.16	0.17	-2.55	1.28	1.39	
78.001	5	0	0	0	0	0	0	

11.B. EverStress Excel Files for Each Vehicle Classification

EverStress Input Files For Class 6 Analyses

Class 2

No. Loads	2	No. of x-y Eval. Points	1

Load Information		
x-position (cm)	0	0
y-position (cm)	0	335.28
Load (N)	67,610	73,170
Pressure (kPa)	220.63	220.63
Radius (cm)*	-	-
Axle	2nd	1st
Number of Tires per Axle	2	2

Evaluation Points (cm)	
x-position	0
y-position	0
z-position	26.999
z-position	77.999
z-position	
z-position	
z-position	

Class 3

No. Loads	2	No. of x-y Eval. Points	1

Load Information		
x-position (cm)	0	0
y-position (cm)	0	335.28
Load (N)	67,610	73,170
Pressure (kPa)	220.63	220.63
Radius (cm)*	-	-
Axle	2	1
Number of Tires per Axle	2	2

Evaluation Points (cm)	
x-position	0
y-position	0
z-position	26.999
z-position	77.999
z-position	
z-position	
z-position	

Class 4

No. Loads	3	No. of x-y Eval. Points	3

Load Information			
x-position (cm)	0	32.92	0
y-position (cm)	0	0	762
Load (N)	33,805	33,805	73,170
Pressure (kPa)	690	690	690
Radius (cm)*	-	-	-
Axle	2	2	1
Number of Tires per Axle	4	4	2

Evaluation Points (cm)			
x-position	0	16.46	32.92
y-position	0	0	0
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Class 5

No. Loads	3	No. of x-y Eval. Points	3

Load Information			
x-position (cm)	0	32.92	0
y-position (cm)	0	0	609.6
Load (N)	33,805	33,805	73,170
Pressure (kPa)	690	690	690
Radius (cm)*	-	-	-
Axle	2	2	1
Number of Tires per Axle	4	4	2

Evaluation Points (cm)			
x-position	0	16.46	32.92
y-position	0	0	0
z-position	26.999	26.999	26.999
z-position	77.999	77.999	77.999
z-position			
z-position			
z-position			

Class 6

No. Loads	5	No. of x-y Eval. Points	6

Load Information					
x-position (cm)	0	32.92	0	32.92	0
y-position (cm)	0	0	777.24	777.24	1219.2
Load (N)	34,583	34,583	33,805	33,805	73,170
Pressure (kPa)	690	690	690	690	690
Radius (cm)*	-	-	-	-	-
Axle	3rd axel	3rd axel	2nd axel	2nd axel	1st axel
Number of Tires per Axle	4	4	4	4	2

Evaluation Points (cm)						
x-position	0	16.46	0	16.46	0	16.46
y-position	0	0	388.62	388.62	777.24	777.24
z-position	26.999	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999	77.999
z-position						
z-position						
z-position						

Class 7

No. Loads	7	No. of x-y Eval. Points	5

Load Information							
x-position (cm)	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	1082.04	1082.04	1524
Load (N)	31,136	31,136	34,583	34,583	33,805	33,805	73,170
Pressure (kPa)	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-
Axle	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Class 8

No. Loads	7	No. of x-y Eval. Points	5

Load Information							
x-position (cm)	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	1082.04	1082.04	1524
Load (N)	31,136	31,136	34,583	34,583	33,805	33,805	73,170
Pressure (kPa)	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-
Axle	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Class 9

No. Loads 9 No. of x-y Eval. Points 5

Load Information									
x-position (cm)	0	32.92	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	1234.44	1234.44	1356.36	1356.36	1889.76
Load (N)	32,359	32,359	31,136	31,136	34,583	34,583	33,805	33,805	73,170
Pressure (kPa)	690	690	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-	-	-
Axle	5	5	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Grey, not in analysis

Class 10

No. Loads 11 No. of x-y Eval. Points 5

Load Information											
x-position (cm)	0	32.92	0	32.92	0	32.92	0	32.92	0	32.92	0
y-position (cm)	0	0	121.92	121.92	243.84	243.84	1325.88	1325.88	1447.8	1447.8	1981.2
Load (N)	33,582	33,582	32,359	32,359	31,136	31,136	34,583	34,583	33,805	33,805	73,170
Pressure (kPa)	690	690	690	690	690	690	690	690	690	690	690
Radius (cm)*	-	-	-	-	-	-	-	-	-	-	-
Axle	6	6	5	5	4	4	3	3	2	2	1
Number of Tires per Axle	4	4	4	4	4	4	4	4	4	4	2

Evaluation Points (cm)					
x-position	0	16.46	32.92	0	16.46
y-position	0	0	0	56.46	56.46
z-position	26.999	26.999	26.999	26.999	26.999
z-position	77.999	77.999	77.999	77.999	77.999
z-position					
z-position					
z-position					

Grey, not in analysis

EverStress Output Files For Class 6 Analyses

(1) At 10ºC

CLayered Elastic Analysis by EverStress for Windows

Title: Class 6, 10C

No of Layers: 5	No of Loads: 5	No of X-Y Evaluation Points: 6

Layer	Poisson's	Thickness	Moduli(1)
*	Ratio	(cm)	(MPa)
1	0.35	3.5	5323
2	0.4	4	2000
3	0.4	19.5	2000
4	0.4	51	150
5	0.4	*	20

Load No	X-Position	Y-Position	Load	Pressure	Radius
*	(cm)	(cm)	(N)	(kPa)	(cm)
1	0	0	26354	690	11.026
2	32.92	0	26354	690	11.026
3	0	777.24	26132	690	10.98
4	32.92	777.24	26132	690	10.98
5	0	1219.2	40699	690	13.702

			z-position (26.999cm)	
Location	x-postion	y-postion	Exx (10^{-6})	Eyy (10^{-6})
1	0	0	114.5	163.64
2	16.46	0	101.88	172.65
3	0	388.67	2.49	-6.59
4	16.46	388.67	2.51	-6.62
5	0	777.24	114.3	160.6
6	16.46	777.24	101.62	169.52

	x-postion	y-postion	Max	x-postion	y-postion	Min
Exx	0	0	114.5	0	388.67	2.49
Eyy	16.46	0	172.65	16.46	388.67	-6.62

Location No: 1 **X-Position (cm): .000** **Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	397.43	467.62	-46.55	0	9.35	-0.01
77.999	4	29.62	30.68	-7.07	0.03	0.73	-0.01

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	114.5	163.64	-196.29	-18.08	0.64	907.556
77.999	4	134.49	144.43	-207.96	-23.068	-7.263	800.067

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-46.75	397.63	467.62	-196.42	114.64	163.64
77.999	4	-7.09	29.63	30.68	-208.09	134.63	144.44

Location No: 2 **X-Position (cm): 16.460** **Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	375.53	476.63	-47.18	0	0	0
77.999	4	31.26	31.76	-7.3	0.03	0	0

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	101.88	172.65	-194.03	-0.008	0.639	919.23
77.999	4	143.17	147.84	-216.71	0.016	-7.268	806.098

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.18	375.53	476.63	-194.03	101.88	172.65
77.999	4	-7.3	31.26	31.76	-216.71	143.17	147.84

Location No: 3	**X-Position (cm): .000**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.44	-13.41	-0.11	0	0.01	0
77.999	4	0.6	-4.38	-0.31	0.01	0.02	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.49	-6.59	2.71	-0.415	0.209	451.016
77.999	4	16.5	-29.99	8.03	-2.652	-3.656	453.608
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13.41	-0.44	-0.11	-6.59	2.49	2.71
77.999	4	-4.38	-0.31	0.6	-29.99	8.02	16.51

Location No: 4	**X-Position (cm): 16.460**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.41	-13.45	-0.11	0	0	0.01
77.999	4	0.61	-4.4	-0.31	0.01	0	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.51	-6.62	2.71	-0.003	0.209	451.388
77.999	4	16.62	-30.11	8.03	0.078	-3.652	453.981
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13.45	-0.41	-0.11	-6.62	2.51	2.71
77.999	4	-4.4	-0.31	0.61	-30.11	8.03	16.62

Location No: 5	**X-Position (cm): .000**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	394.29	460.44	-46.21	0.04	9.27	0.01
77.999	4	29.48	29.17	-7.08	0.1	0.72	0.01
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	114.3	160.6	-194.05	-17.931	-2.747	987.651
77.999	4	137.63	134.73	-203.58	-22.877	-13.087	881.881
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-46.41	394.49	460.44	-194.19	114.44	160.6
77.999	4	-7.09	29.17	29.5	-203.72	134.73	137.76
Location No: 6	**X-Position (cm): 16.460**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	372.18	469.18	-46.82	0.04	0	0.13
77.999	4	31.11	30.24	-7.3	0.1	0	0.05
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	101.62	169.52	-191.68	0.1	-2.738	999.12
77.999	4	146.21	138.13	-212.27	0.713	-13.041	887.762
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-46.82	372.18	469.18	-191.68	101.62	169.52
77.999	4	-7.3	30.24	31.11	-212.27	138.11	146.24

(2) At 11ºC

CLayered Elastic Analysis by EverStress for Windows

Title: Class 6, 11C

No of	No of Loads:	No of X-Y	
Layer	Poisson's	Thickness	Moduli(1)
*	Ratio	(cm)	(MPa)
1	0.35	3.5	4844
2	0.4	4	2000
3	0.4	19.5	2000
4	0.4	51	150
5	0.4	*	20

Load No	X-Position	Y-Position	Load	Pressure	Radius
*	(cm)	(cm)	(N)	(kPa)	(cm)
1	0	0	26354	690	11.026
2	32.92	0	26354	690	11.026
3	0	777.24	26132	690	10.98
4	32.92	777.24	26132	690	10.98
5	0	1219.2	40699	690	13.702

			z-position (26.999cm)	
Location	x-postion	y-postion	Exx (10^{-6})	Eyy (10^{-6})
1	0	0	114.98	164.55
2	16.46	0	102.15	173.61
3	0	388.67	2.38	-6.45
4	16.46	388.67	2.4	-6.48
5	0	777.24	114.74	161.55
6	16.46	777.24	101.86	170.51

	x-postion	y-postion	Max	x-postion	y-postion	Min
Exx	0	0	114.98	0	388.67	2.38
Eyy	16.46	0	173.61	16.46	388.67	-6.48

Location No: 1	**X-Position (cm): .000**	**Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	399.02	469.84	-47.15	0	9.45	-0.01
77.999	4	29.96	31.05	-7.16	0.03	0.74	-0.01

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	114.98	164.55	-197.35	-18.144	0.734	913.04
77.999	4	136.01	146.21	-210.43	-23.334	-7.159	804.47

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.35	399.22	469.84	-197.49	115.12	164.55
77.999	4	-7.18	29.97	31.05	-210.57	136.15	146.21

Location No: 2	**X-Position (cm): 16.460**	**Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	376.69	478.77	-47.8	0	0	0
77.999	4	31.63	32.15	-7.39	0.03	0	0

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	102.15	173.61	-194.99	-0.008	0.733	924.894
77.999	4	144.84	149.67	-219.33	0.016	-7.163	810.601

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.8	376.69	478.77	-194.99	102.15	173.61
77.999	4	-7.39	31.63	32.15	-219.33	144.84	149.67

Location No: 3	X-Position (cm): .000	Y-Position (cm): 388.620					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.56	-13.18	-0.11	0	0.01	0
77.999	4	0.58	-4.39	-0.3	0.01	0.02	0
			cNormal Strains and Deflections				
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.38	-6.45	2.69	-0.398	0.253	450.658
77.999	4	16.42	-30.04	8.14	-2.639	-3.606	453.278
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13.18	-0.56	-0.11	-6.45	2.38	2.69
77.999	4	-4.39	-0.3	0.58	-30.04	8.13	16.42
Location No: 4	X-Position (cm): 16.460	Y-Position (cm): 388.620					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.53	-13.22	-0.11	0	0	0.01
77.999	4	0.6	-4.41	-0.3	0.01	0	0
			cNormal Strains and Deflections				
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.4	-6.48	2.7	-0.004	0.253	451.031
77.999	4	16.54	-30.16	8.13	0.077	-3.602	453.65
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13.22	-0.53	-0.11	-6.48	2.4	2.7
77.999	4	-4.41	-0.3	0.6	-30.16	8.13	16.54

Location No: 5	X-Position (cm): .000	Y-Position (cm): 777.240					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	395.85	462.72	-46.81	0.04	9.37	0.01
77.999	4	29.81	29.53	-7.16	0.1	0.74	0.01
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	114.74	161.55	-195.12	-17.995	-2.681	992.956
77.999	4	139.11	136.49	-206.02	-23.142	-13.038	886.117
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.01	396.05	462.72	-195.26	114.88	161.55
77.999	4	-7.18	29.53	29.83	-206.16	136.49	139.25

Location No: 6	X-Position (cm): 16.460	Y-Position (cm): 777.240					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	373.29	471.38	-47.43	0.04	0	0.13
77.999	4	31.47	30.62	-7.39	0.1	0	0.05
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	101.86	170.51	-192.65	0.095	-2.673	1004.603
77.999	4	147.83	139.95	-214.85	0.709	-12.993	892.098
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.43	373.3	471.38	-192.65	101.86	170.51
77.999	4	-7.39	30.62	31.47	-214.85	139.93	147.86

(3) At 12ºC

CLayered Elastic Analysis by EverStress for Windows

Title: Class 6, 12C

No of	No of Loads:	No of X-Y	
Layer	Poisson's	Thickness	Moduli(1)
*	Ratio	(cm)	(MPa)
1	0.35	3.5	4407
2	0.4	4	2000
3	0.4	19.5	2000
4	0.4	51	150
5	0.4	*	20

			z-position (26.999cm)	
Location	x-postion	y-postion	Exx (10^{-6})	Eyy (10^{-6})
1	0	0	115.46	165.47
2	16.46	0	102.44	174.58
3	0	388.67	2.27	-6.32
4	16.46	388.67	2.3	-6.35
5	0	777.24	115.2	162.51
6	16.46	777.24	102.12	171.52

	x-postion	y-postion	Max	x-postion	y-postion	Min
Exx	0	0	115.46	0	388.67	2.27
Eyy	16.46	0	174.58	16.46	388.67	-6.35

Load No	X-Position	Y-Position	Load	Pressure	Radius
*	(cm)	(cm)	(N)	(kPa)	(cm)
1	0	0	26354	690	11.026
2	32.92	0	26354	690	11.026
3	0	777.24	26132	690	10.98
4	32.92	777.24	26132	690	10.98
5	0	1219.2	40699	690	13.702

Location No: 1 **X-Position (cm): .000** **Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	400.65	472.1	-47.76	0	9.55	-0.01
77.999	4	30.29	31.42	-7.25	0.03	0.75	-0.01

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	115.46	165.47	-198.43	-18.211	0.823	918.449
77.999	4	137.53	147.99	-212.9	-23.601	-7.06	808.792

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.96	400.86	472.1	-198.57	115.6	165.47
77.999	4	-7.27	30.31	31.42	-213.04	137.67	147.99

Location No: 2 **X-Position (cm): 16.460** **Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	377.9	480.96	-48.42	0	0	0
77.999	4	31.99	32.53	-7.48	0.03	0	0

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	102.44	174.58	-195.98	-0.009	0.822	930.485
77.999	4	146.5	151.5	-221.95	0.016	-7.065	815.025

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-48.42	377.9	480.96	-195.98	102.44	174.58
77.999	4	-7.48	31.99	32.53	-221.95	146.5	151.5

Location No: 3	X-Position (cm): .000	Y-Position (cm): 388.620					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.67	-12.95	-0.11	0	0.01	0
77.999	4	0.57	-4.4	-0.3	0.01	0.02	0
Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.27	-6.32	2.67	-0.382	0.295	450.307
77.999	4	16.34	-30.08	8.24	-2.626	-3.558	452.952
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-12.95	-0.67	-0.11	-6.32	2.27	2.67
77.999	4	-4.4	-0.3	0.57	-30.08	8.23	16.34
Location No: 4	**X-Position (cm): 16.460**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.65	-13	-0.11	0	0	0
77.999	4	0.58	-4.42	-0.3	0.01	0	0
Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.3	-6.35	2.68	-0.005	0.295	450.679
77.999	4	16.45	-30.2	8.24	0.076	-3.554	453.324
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-13	-0.65	-0.11	-6.35	2.3	2.68
77.999	4	-4.42	-0.3	0.58	-30.21	8.24	16.45

Location No: 5	**X-Position (cm): .000**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	397.45	465.03	-47.41	0.04	9.47	0.01
77.999	4	30.15	29.9	-7.25	0.1	0.75	0.01
Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	115.2	162.51	-196.2	-18.061	-2.619	998.19
77.999	4	140.59	138.25	-208.45	-23.406	-12.991	890.277
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-47.61	397.65	465.03	-196.34	115.34	162.51
77.999	4	-7.27	29.9	30.16	-208.59	138.25	140.73
Location No: 6	**X-Position (cm): 16.460**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	374.48	473.62	-48.04	0.04	0	0.12
77.999	4	31.83	31.01	-7.48	0.1	0	0.05
Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	102.12	171.52	-193.64	0.091	-2.611	1010.017
77.999	4	149.46	141.77	-217.43	0.704	-12.946	896.359
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-48.04	374.48	473.62	-193.64	102.12	171.52
77.999	4	-7.48	31	31.83	-217.43	141.74	149.49

(4) At 13ºC

CLayered Elastic Analysis by EverStress for Windows

Title: Class 6, 13C

No of	No of Loads:	No of X-Y

Layer	Poisson's	Thickness	Moduli(1)
*	Ratio	(cm)	(MPa)
1	0.35	3.5	4011
2	0.4	4	2000
3	0.4	19.5	2000
4	0.4	51	150
5	0.4	*	20

Location	x-postion	y-postion	z-position (26.999cm) Exx (10^{-6})	Eyy (10^{-6})
1	0	0	115.95	166.4
2	16.46	0	102.75	175.57
3	0	388.67	2.18	-6.19
4	16.46	388.67	2.2	-6.22
5	0	777.24	115.66	163.47
6	16.46	777.24	102.4	172.54

	x-postion	y-postion	Max	x-postion	y-postion	Min
Exx	0	0	115.95	0	388.67	2.18
Eyy	16.46	0	175.57	16.46	388.67	-6.22

Load No	X-Position	Y-Position	Load	Pressure	Radius
*	(cm)	(cm)	(N)	(kPa)	(cm)
1	0	0	26354	690	11.026
2	32.92	0	26354	690	11.026
3	0	777.24	26132	690	10.98
4	32.92	777.24	26132	690	10.98
5	0	1219.2	40699	690	13.702

Location No: 1	**X-Position (cm): .000**	**Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	402.31	474.38	-48.36	0	9.65	-0.01
77.999	4	30.63	31.78	-7.34	0.03	0.76	-0.01

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	115.95	166.4	-199.52	-18.28	0.907	923.729
77.999	4	139.03	149.74	-215.34	-23.864	-6.967	812.993

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-48.57	402.51	474.38	-199.66	116.09	166.4
77.999	4	-7.35	30.65	31.78	-215.49	139.17	149.74

Location No: 2	**X-Position (cm): 16.460**	**Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	379.17	483.19	-49.04	0	0	0
77.999	4	32.36	32.91	-7.57	0.03	0	0

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	102.75	175.57	-196.99	-0.009	0.906	935.947
77.999	4	148.15	153.32	-224.54	0.015	-6.972	819.325

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-49.04	379.17	483.19	-196.99	102.75	175.57
77.999	4	-7.57	32.36	32.91	-224.54	148.15	153.32

Location No: 3	**X-Position (cm): .000**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.78	-12.74	-0.1	0	0.01	0
77.999	4	0.56	-4.41	-0.29	0.01	0.02	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.18	-6.19	2.65	-0.367	0.334	449.965
77.999	4	16.26	-30.13	8.33	-2.614	-3.513	452.634
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-12.74	-0.78	-0.1	-6.19	2.18	2.65
77.999	4	-4.41	-0.29	0.56	-30.13	8.33	16.26
Location No: 4	**X-Position (cm): 16.460**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.75	-12.78	-0.1	0	0	0
77.999	4	0.57	-4.43	-0.29	0.01	0	0
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.2	-6.22	2.66	-0.006	0.334	450.338
77.999	4	16.37	-30.25	8.33	0.075	-3.51	453.007
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-12.78	-0.75	-0.1	-6.22	2.2	2.66
77.999	4	-4.43	-0.29	0.57	-30.25	8.33	16.37

Location No: 5	X-Position (cm): .000	Y-Position (cm): 777.240					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	399.07	467.37	-48.01	0.04	9.57	0.01
77.999	4	30.48	30.25	-7.34	0.1	0.76	0.01
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	115.66	163.47	-197.29	-18.13	-2.559	1003.301
77.999	4	142.05	139.99	-210.85	-23.667	-12.945	894.321
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-48.21	399.27	467.37	-197.43	115.8	163.47
77.999	4	-7.35	30.25	30.49	-210.99	139.99	142.2
Location No: 6	X-Position (cm): 16.460	Y-Position (cm): 777.240					
Iormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	375.71	475.9	-48.66	0.03	0	0.12
77.999	4	32.19	31.38	-7.57	0.1	0	0.05
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	102.4	172.54	-194.65	0.086	-2.552	1015.309
77.999	4	151.07	143.57	-219.97	0.7	-12.9	900.502
l Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-48.66	375.71	475.9	-194.65	102.4	172.54
77.999	4	-7.57	31.38	32.19	-219.98	143.54	151.1

(5) At 14ºC

CLayered Elastic Analysis by EverStress for Windows

Title: Class 6, 14C

No of	No of Loads:	No of X-Y	
Layer	Poisson's	Thickness	Moduli(1)
*	Ratio	(cm)	(MPa)
1	0.35	3.5	3649
2	0.4	4	2000
3	0.4	19.5	2000
4	0.4	51	150
5	0.4	*	20

Load No	X-Position	Y-Position	Load	Pressure	Radius
*	(cm)	(cm)	(N)	(kPa)	(cm)
1	0	0	26354	690	11.026
2	32.92	0	26354	690	11.026
3	0	777.24	26132	690	10.98
4	32.92	777.24	26132	690	10.98
5	0	1219.2	40699	690	13.702

			z-position (26.999cm)	
Location	x-postion	y-postion	Exx (10^{-6})	Eyy (10^{-6})
1	0	0	116.45	167.34
2	16.46	0	103.08	176.57
3	0	388.67	2.08	-6.07
4	16.46	388.67	2.11	-6.09
5	0	777.24	116.13	164.45
6	16.46	777.24	102.7	173.57

	x-postion	y-postion	Max	x-postion	y-postion	Min
Exx	0	0	116.45	0	388.67	2.08
Eyy	16.46	0	176.57	16.46	388.67	-6.09

Location No: 1 **X-Position (cm): .000** **Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	403.99	476.7	-48.96	0	9.75	-0.01
77.999	4	30.96	32.14	-7.42	0.03	0.78	-0.01

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	116.45	167.34	-200.62	-18.351	0.986	928.909
77.999	4	140.52	151.48	-217.76	-24.125	-6.88	817.095

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-49.17	404.2	476.7	-200.77	116.59	167.34
77.999	4	-7.44	30.98	32.14	-217.91	140.66	151.48

Location No: 2 **X-Position (cm): 16.460** **Y-Position (cm): .000**

cNormal Stresses

Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	380.48	485.47	-49.66	0	0	0
77.999	4	32.72	33.29	-7.66	0.03	0	0

cNormal Strains and Deflections

Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	103.08	176.57	-198.02	-0.009	0.985	941.309
77.999	4	149.78	155.11	-227.11	0.015	-6.884	823.526

cPrincipal Stresses and Strains

Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-49.66	380.48	485.47	-198.02	103.08	176.57
77.999	4	-7.66	32.72	33.29	-227.11	149.79	155.11

Location No: 3	**X-Position (cm): .000**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.88	-12.53	-0.1	0	0.01	0
77.999	4	0.54	-4.42	-0.29	0.01	0.02	0
		cNormal Strains and Deflections					
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.08	-6.07	2.63	-0.352	0.371	449.632
77.999	4	16.18	-30.16	8.42	-2.603	-3.471	452.324
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-12.53	-0.88	-0.1	-6.07	2.08	2.63
77.999	4	-4.42	-0.29	0.54	-30.16	8.42	16.19
Location No: 4	**X-Position (cm): 16.460**	**Y-Position (cm): 388.620**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	-0.86	-12.57	-0.1	0	0	0
77.999	4	0.55	-4.44	-0.29	0.01	0	0
		cNormal Strains and Deflections					
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	2.11	-6.09	2.64	-0.007	0.371	450.005
77.999	4	16.3	-30.29	8.42	0.074	-3.468	452.696
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-12.57	-0.86	-0.1	-6.09	2.11	2.64
77.999	4	-4.44	-0.29	0.55	-30.29	8.42	16.3

Location No: 5	**X-Position (cm): .000**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	400.72	469.74	-48.6	0.03	9.67	0.01
77.999	4	30.8	30.61	-7.42	0.1	0.77	0.01
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	116.13	164.45	-198.39	-18.2	-2.503	1008.317
77.999	4	143.5	141.72	-213.23	-23.926	-12.9	898.271
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-48.81	400.93	469.74	-198.54	116.28	164.45
77.999	4	-7.43	30.61	30.82	-213.38	141.72	143.65
Location No: 6	**X-Position (cm): 16.460**	**Y-Position (cm): 777.240**					
cNormal Stresses							
Z-Position	Layer	Sxx	Syy	Szz	Syz	Sxz	Sxy
(cm)	*	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)
26.999	3	376.99	478.23	-49.27	0.03	0	0.11
77.999	4	32.54	31.76	-7.66	0.1	0	0.05
cNormal Strains and Deflections							
Z-Position	Layer	Exx	Eyy	Ezz	Ux	Uy	Uz
(cm)	*	(10^-6)	(10^-6)	(10^-6)	(microns)	(microns)	(microns)
26.999	3	102.7	173.57	-195.68	0.082	-2.495	1020.506
77.999	4	152.67	145.36	-222.5	0.696	-12.855	904.55
cPrincipal Stresses and Strains							
Z-Position	Layer	S1	S2	S3	E1	E2	E3
(cm)	*	(kPa)	(kPa)	(kPa)	(10^-6)	(10^-6)	(10^-6)
26.999	3	-49.27	376.99	478.23	-195.68	102.7	173.57
77.999	4	-7.66	31.75	32.54	-222.51	145.33	152.7

11.C. *EverStress Excel Output Summary Files By Axle Configuration*

(1) Transverse Strain Files

500 lbs per Tire										
	Transverse Strain (10^{-6})					Percentage of Single Transverse Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	10.77	12.38	11.88	12.81	12.12	100.0%	114.9%	110.3%	118.9%	112.5%
10	10.83	12.42	11.92	12.83	12.15	100.0%	114.7%	110.1%	118.5%	112.2%
11	10.89	12.46	11.96	12.86	12.19	100.0%	114.4%	109.8%	118.1%	111.9%
12	10.94	12.5	12	12.89	12.22	100.0%	114.3%	109.7%	117.8%	111.7%
13	11	12.54	12.05	12.92	12.25	100.0%	114.0%	109.5%	117.5%	111.4%
14	11.06	12.58	12.09	12.95	12.29	100.0%	113.7%	109.3%	117.1%	111.1%
15	11.12	12.62	12.13	12.99	12.33	100.0%	113.5%	109.1%	116.8%	110.9%
16	11.17	12.66	12.18	13.02	12.37	100.0%	113.3%	109.0%	116.6%	110.7%
17	11.23	12.71	12.22	13.06	12.41	100.0%	113.2%	108.8%	116.3%	110.5%
18	11.29	12.75	12.27	13.09	12.44	100.0%	112.9%	108.7%	115.9%	110.2%
19	11.34	12.79	12.31	13.13	12.48	100.0%	112.8%	108.6%	115.8%	110.1%

1500 lbs per Tire										
	Transverse Strain (10^{-6})					Percentage of Single Transverse Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	31.58	36.41	34.91	35.63	35.63	100.00%	115.29%	110.54%	112.82%	112.82%
10	31.74	36.51	35.02	35.71	35.71	100.00%	115.03%	110.33%	112.51%	112.51%
11	31.88	36.62	35.13	35.8	35.8	100.00%	114.87%	110.19%	112.30%	112.30%
12	32.06	36.72	35.24	35.89	35.89	100.00%	114.54%	109.92%	111.95%	111.95%
13	32.22	36.83	35.36	35.98	35.98	100.00%	114.31%	109.75%	111.67%	111.67%
14	32.38	36.95	35.47	36.08	36.08	100.00%	114.11%	109.54%	111.43%	111.43%
15	32.55	37.06	35.59	36.18	36.18	100.00%	113.86%	109.34%	111.15%	111.15%
16	32.71	37.18	35.72	36.29	36.29	100.00%	113.67%	109.20%	110.94%	110.94%
17	32.87	37.3	35.84	36.4	36.4	100.00%	113.48%	109.04%	110.74%	110.74%
18	33.04	37.42	35.97	36.5	36.5	100.00%	113.26%	108.87%	110.47%	110.47%
19	33.2	37.54	36.09	36.62	36.62	100.00%	113.07%	108.70%	110.30%	110.30%

2500 lbs per Tire										
	Transverse Strain (10^{-6})					Percentage of Single Transverse Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	51.49	59.54	57.04	61.65	58.23	100.00%	115.63%	110.78%	119.73%	113.09%
10	51.73	59.69	57.2	61.75	58.35	100.00%	115.39%	110.57%	119.37%	112.80%
11	51.98	59.84	57.37	61.85	58.48	100.00%	115.12%	110.37%	118.99%	112.50%
12	52.24	60.01	57.54	61.97	58.62	100.00%	114.87%	110.15%	118.63%	112.21%
13	52.49	60.17	57.71	62.09	58.76	100.00%	114.63%	109.94%	118.29%	111.95%
14	52.75	60.35	57.9	62.22	58.91	100.00%	114.41%	109.76%	117.95%	111.68%
15	53	60.52	58.08	62.35	59.07	100.00%	114.19%	109.58%	117.64%	111.45%
16	53.26	60.71	58.27	62.49	59.23	100.00%	113.99%	109.41%	117.33%	111.21%
17	53.52	60.89	58.46	62.64	59.39	100.00%	113.77%	109.23%	117.04%	110.97%
18	53.77	61.08	58.66	62.79	59.56	100.00%	113.59%	109.09%	116.78%	110.77%
19	54.03	61.26	58.85	62.94	59.73	100.00%	113.38%	108.92%	116.49%	110.55%

3500 lbs per Tire										
	Transverse Strain (10^{-6})					Percentage of Single Transverse Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	70.58	81.85	78.36	84.8	80.02	100.00%	115.97%	111.02%	120.15%	113.37%
10	70.91	82.04	78.56	84.92	80.17	100.00%	115.70%	110.79%	119.76%	113.06%
11	71.24	82.24	78.77	85.05	80.33	100.00%	115.44%	110.57%	119.39%	112.76%
12	71.57	82.45	78.99	85.19	80.5	100.00%	115.20%	110.37%	119.03%	112.48%
13	71.91	82.66	79.22	85.34	80.69	100.00%	114.95%	110.17%	118.68%	112.21%
14	72.25	82.88	79.45	85.5	80.88	100.00%	114.71%	109.97%	118.34%	111.94%
15	72.59	83.11	79.69	85.67	81.07	100.00%	114.49%	109.78%	118.02%	111.68%
16	72.93	83.35	79.94	85.85	81.28	100.00%	114.29%	109.61%	117.72%	111.45%
17	73.27	83.59	80.19	86.04	81.49	100.00%	114.08%	109.44%	117.43%	111.22%
18	73.61	83.83	80.45	86.23	81.71	100.00%	113.88%	109.29%	117.14%	111.00%
19	73.95	84.08	80.7	86.42	81.93	100.00%	113.70%	109.13%	116.86%	110.79%

4500 lbs per Tire										
	Transverse Strain (10^{-6})					Percentage of Single Transverse Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	88.95	103.43	98.94	107.23	101.08	100.00%	116.28%	111.23%	120.55%	113.64%
10	89.34	103.65	99.18	107.36	101.25	100.00%	116.02%	111.01%	120.17%	113.33%
11	89.74	103.88	99.43	107.5	101.43	100.00%	115.76%	110.80%	119.79%	113.03%
12	90.15	104.13	99.69	107.65	101.63	100.00%	115.51%	110.58%	119.41%	112.73%
13	90.55	104.38	99.95	107.82	101.84	100.00%	115.27%	110.38%	119.07%	112.47%
14	90.97	104.64	100.23	108.01	102.07	100.00%	115.03%	110.18%	118.73%	112.20%
15	91.39	104.92	100.52	108.2	102.3	100.00%	114.80%	109.99%	118.39%	111.94%
16	91.8	105.2	100.82	108.41	102.54	100.00%	114.60%	109.83%	118.09%	111.70%
17	92.22	105.48	101.12	108.63	102.79	100.00%	114.38%	109.65%	117.79%	111.46%
18	92.64	105.77	101.42	108.86	103.05	100.00%	114.17%	109.48%	117.51%	111.24%
19	93.05	106.07	101.73	109.09	103.31	100.00%	113.99%	109.33%	117.24%	111.03%

(2) Longitudinal Strain Files

500 lbs per Tire										
	Longitudinal Strain (10^{-6})					Percentage of Single Longitudinal Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	15.58	14.44	14.58	13.82	14.14	100.0%	92.7%	93.6%	88.7%	90.8%
10	15.67	14.51	14.66	13.89	14.23	100.0%	92.6%	93.6%	88.6%	90.8%
11	15.75	14.58	14.75	13.97	14.32	100.0%	92.6%	93.7%	88.7%	90.9%
12	15.84	14.65	14.83	14.05	14.41	100.0%	92.5%	93.6%	88.7%	91.0%
13	15.94	14.73	14.92	14.13	14.5	100.0%	92.4%	93.6%	88.6%	91.0%
14	16.03	14.81	15.01	14.22	14.59	100.0%	92.4%	93.6%	88.7%	91.0%
15	16.12	14.89	15.09	14.3	14.69	100.0%	92.4%	93.6%	88.7%	91.1%
16	16.21	14.97	15.18	14.39	14.78	100.0%	92.4%	93.6%	88.8%	91.2%
17	16.31	15.05	15.27	14.47	14.87	100.0%	92.3%	93.6%	88.7%	91.2%
18	16.4	15.13	15.36	14.55	14.97	100.0%	92.3%	93.7%	88.7%	91.3%
19	16.49	15.21	15.45	14.64	15.06	100.0%	92.2%	93.7%	88.8%	91.3%

1500 lbs per Tire										
	Longitudinal Strain (10^{-6})					Percentage of Single Longitudinal Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	46.12	42.69	43.14	40.85	41.81	100.00%	92.56%	93.54%	88.57%	90.65%
10	46.38	42.9	43.37	41.07	42.07	100.00%	92.50%	93.51%	88.55%	90.71%
11	46.61	43.11	43.62	41.3	42.33	100.00%	92.49%	93.59%	88.61%	90.82%
12	46.9	43.33	43.87	41.53	42.59	100.00%	92.39%	93.54%	88.55%	90.81%
13	47.17	43.56	44.12	41.77	42.86	100.00%	92.35%	93.53%	88.55%	90.86%
14	47.44	43.79	44.37	42.01	43.14	100.00%	92.31%	93.53%	88.55%	90.94%
15	47.72	44.02	44.63	42.26	43.41	100.00%	92.25%	93.52%	88.56%	90.97%
16	47.99	44.25	44.9	42.51	43.69	100.00%	92.21%	93.56%	88.58%	91.04%
17	48.26	44.49	45.16	42.76	43.97	100.00%	92.19%	93.58%	88.60%	91.11%
18	48.54	44.73	45.42	43.01	44.24	100.00%	92.15%	93.57%	88.61%	91.14%
19	48.8	44.96	45.68	43.25	44.51	100.00%	92.13%	93.61%	88.63%	91.21%

2500 lbs per Tire										
	Longitudinal Strain (10^{-6})					Percentage of Single Longitudinal Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	75.86	70.15	70.89	67.07	68.67	100.00%	92.47%	93.45%	88.41%	90.52%
10	76.28	70.49	71.28	67.44	69.09	100.00%	92.41%	93.45%	88.41%	90.57%
11	76.71	70.84	71.67	67.81	69.52	100.00%	92.35%	93.43%	88.40%	90.63%
12	77.14	71.2	72.08	68.19	69.96	100.00%	92.30%	93.44%	88.40%	90.69%
13	77.58	71.56	72.49	68.58	70.4	100.00%	92.24%	93.44%	88.40%	90.75%
14	78.02	71.93	72.91	68.97	70.85	100.00%	92.19%	93.45%	88.40%	90.81%
15	78.47	72.31	73.34	69.38	71.3	100.00%	92.15%	93.46%	88.42%	90.86%
16	78.92	72.69	73.76	69.79	71.75	100.00%	92.11%	93.46%	88.43%	90.91%
17	79.37	73.08	74.19	70.2	72.21	100.00%	92.08%	93.47%	88.45%	90.98%
18	79.81	73.47	74.62	70.6	72.66	100.00%	92.06%	93.50%	88.46%	91.04%
19	80.25	73.86	75.05	71.01	73.1	100.00%	92.04%	93.52%	88.49%	91.09%

3500 lbs per Tire										
	Longitudinal Strain (10^{-6})					Percentage of Single Longitudinal Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	104.82	96.84	97.86	92.53	94.77	100.00%	92.39%	93.36%	88.28%	90.41%
10	105.4	97.3	98.39	93.02	95.34	100.00%	92.31%	93.35%	88.25%	90.46%
11	105.98	97.77	98.94	93.53	95.93	100.00%	92.25%	93.36%	88.25%	90.52%
12	106.58	98.26	99.49	94.06	96.53	100.00%	92.19%	93.35%	88.25%	90.57%
13	107.18	98.76	100.06	94.59	97.14	100.00%	92.14%	93.36%	88.25%	90.63%
14	107.79	99.27	100.64	95.13	97.75	100.00%	92.10%	93.37%	88.25%	90.69%
15	108.41	99.79	101.22	95.68	98.37	100.00%	92.05%	93.37%	88.26%	90.74%
16	109.02	100.31	101.81	96.24	98.99	100.00%	92.01%	93.39%	88.28%	90.80%
17	109.64	100.84	102.39	96.8	99.62	100.00%	91.97%	93.39%	88.29%	90.86%
18	110.25	101.38	102.99	97.37	100.24	100.00%	91.95%	93.41%	88.32%	90.92%
19	110.85	101.91	103.57	97.92	100.85	100.00%	91.94%	93.43%	88.34%	90.98%

4500 lbs per Tire										
	Longitudinal Strain (10^{-6})					Percentage of Single Longitudinal Strain				
Temperature (ºC)	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'	Single	Tandem 4'	Tandem 5'	Tridem 4'	Tridem 5'
9	133.03	122.77	124.08	117.23	120.11	100.00%	92.29%	93.27%	88.12%	90.29%
10	133.76	123.35	124.75	117.85	120.83	100.00%	92.22%	93.26%	88.11%	90.33%
11	134.49	123.95	125.44	118.49	121.56	100.00%	92.16%	93.27%	88.10%	90.39%
12	135.25	124.56	126.14	119.15	122.32	100.00%	92.10%	93.26%	88.10%	90.44%
13	136.01	125.19	126.85	119.82	123.09	100.00%	92.04%	93.27%	88.10%	90.50%
14	136.78	125.83	127.58	120.51	123.87	100.00%	91.99%	93.27%	88.10%	90.56%
15	137.55	126.47	128.31	121.2	124.65	100.00%	91.94%	93.28%	88.11%	90.62%
16	138.33	127.14	129.06	121.9	125.44	100.00%	91.91%	93.30%	88.12%	90.68%
17	139.1	127.8	129.79	122.61	126.22	100.00%	91.88%	93.31%	88.15%	90.74%
18	139.87	128.47	130.54	123.32	127.01	100.00%	91.85%	93.33%	88.17%	90.81%
19	140.64	129.14	131.28	124.02	127.78	100.00%	91.82%	93.34%	88.18%	90.86%

11.D. *Thermocouple Data for Traffic Analysis*

Day	1	2	3	4	5	6	Month	Layer 1	Layer 2	Layer 3
			Asphalt							
283	15.189	14.808	13.468	15.302	14.591	13.418	9.4	15.2455	14.6995	13.443
284	15.178	14.685	13.286	15.329	14.501	13.244	9.5	15.2535	14.593	13.265
284	15.142	14.619	13.325	15.296	14.422	13.287	9.5	15.219	14.5205	13.306
284	14.994	14.55	13.273	15.215	14.366	13.235	9.5	15.1045	14.458	13.254
284	15.019	14.53	13.185	15.136	14.316	13.151	9.5	15.0775	14.423	13.168
284	14.975	14.482	13.153	15.05	14.256	13.12	9.5	15.0125	14.369	13.1365
284	14.834	14.387	13.033	15.043	14.198	12.991	9.5	14.9385	14.2925	13.012
284	14.792	14.331	12.57	14.963	14.118	12.536	9.5	14.8775	14.2245	12.553
284	14.774	14.234	12.918	14.849	13.97	12.884	9.5	14.8115	14.102	12.901
284	14.603	14.201	13.2	14.762	13.984	13.153	9.5	14.6825	14.0925	13.1765
284	14.776	14.303	14.609	14.835	14.203	14.504	9.5	14.8055	14.253	14.5565
284	14.875	14.649	15.681	14.929	14.691	15.543	9.5	14.902	14.67	15.612
284	15.006	15.119	15.975	15.069	15.202	15.825	9.5	15.0375	15.1605	15.9
284	15.261	15.407	18.559	15.394	15.586	18.276	9.5	15.3275	15.4965	18.4175
284	15.651	16.152	19.775	15.643	16.49	19.506	9.5	15.647	16.321	19.6405
284	16.186	16.944	20.722	16.032	17.269	20.363	9.5	16.109	17.1065	20.5425
284	16.792	17.495	19.218	16.559	17.848	18.932	9.5	16.6755	17.6715	19.075
284	17.016	17.586	18.026	16.791	17.794	17.802	9.5	16.9035	17.69	17.914
284	17.156	17.41	16.757	16.957	17.468	16.59	9.5	17.0565	17.439	16.6735
284	16.926	17.101	15.859	16.767	17.009	15.729	9.5	16.8465	17.055	15.794
284	16.626	16.642	15.337	16.705	16.567	15.232	9.5	16.6655	16.6045	15.2845
284	16.596	16.35	14.906	16.575	16.229	14.801	9.5	16.5855	16.2895	14.8535
284	16.254	16.087	14.274	16.337	15.887	14.182	9.5	16.2955	15.987	14.228
284	16.111	15.727	14.118	16.24	15.544	14.026	9.5	16.1755	15.6355	14.072
284	15.966	15.527	14.022	16.062	15.327	13.93	9.5	16.014	15.427	13.976
285	15.778	15.336	13.54	15.895	15.127	13.389	9.5	15.8365	15.2315	13.4645
285	15.618	15.113	13.052	15.76	14.837	12.922	9.5	15.689	14.975	12.987
285	15.488	14.857	12.787	15.622	14.565	12.678	9.5	15.555	14.711	12.7325
285	15.194	14.625	12.483	15.453	14.311	12.356	9.5	15.3235	14.468	12.4195
285	15.076	14.394	12.217	15.247	14.072	12.116	9.5	15.1615	14.233	12.1665
285	14.847	14.194	12.092	15.048	13.834	12.029	9.5	14.9475	14.014	12.0605
285	14.743	14.073	12.176	14.81	13.725	12.13	9.5	14.7765	13.899	12.153
285	14.64	13.958	12.284	14.787	13.656	12.216	9.5	14.7135	13.807	12.25
285	14.462	13.889	12.437	14.659	13.616	12.361	9.5	14.5605	13.7525	12.399
285	14.552	13.87	12.477	14.619	13.622	12.401	9.5	14.5855	13.746	12.439
285	14.371	13.84	12.812	14.597	13.643	12.736	9.5	14.484	13.7415	12.774
285	14.464	13.932	12.929	14.505	13.701	12.854	9.5	14.4845	13.8165	12.8915
285	14.33	13.961	13.118	14.472	13.764	13.039	9.5	14.401	13.8625	13.0785
285	14.32	13.973	12.533	14.471	13.771	12.466	9.5	14.3955	13.872	12.4995
285	14.406	13.896	12.364	14.453	13.627	12.284	9.5	14.4295	13.7615	12.324
285	14.39	13.812	12.721	14.453	13.627	12.65	9.5	14.4215	13.7195	12.6855
285	14.292	13.836	12.355	14.326	13.584	12.292	9.5	14.309	13.71	12.3235
285	14.203	13.7	12.155	14.433	13.478	12.096	9.5	14.318	13.589	12.1255
285	14.144	13.599	11.814	14.361	13.372	11.772	9.5	14.2525	13.4855	11.793
285	14.026	13.443	11.611	14.264	13.191	11.603	9.5	14.145	13.317	11.607
285	13.919	13.319	11.542	14.103	13.063	11.529	9.5	14.011	13.191	11.5355
285	13.799	13.238	11.317	14.097	12.969	11.274	9.5	13.948	13.1035	11.2955
285	13.684	13.063	10.909	13.902	12.761	10.88	9.5	13.793	12.912	10.8945
285	13.703	12.872	10.304	13.833	12.528	10.296	9.5	13.768	12.7	10.3
286	13.443	12.612	9.7171	13.62	12.209	9.7425	9.5	13.5315	12.4105	9.7298
286	13.098	12.308	9.4407	13.4	11.887	9.5083	9.5	13.249	12.0975	9.4745
286	13.055	12.063	9.0129	13.265	11.647	9.0468	9.5	13.16	11.855	9.02985
286	12.934	11.799	8.1793	13.177	11.369	8.2132	9.5	13.0555	11.584	8.19625
286	12.47	11.393	8.0714	12.827	10.887	7.9569	9.5	12.6485	11.14	8.01415
286	12.248	11.12	7.9492	12.627	10.686	7.7244	9.5	12.4375	10.903	7.8368
286	12.239	10.887	7.1578	12.424	10.435	7.0814	9.5	12.3315	10.661	7.1196
286	11.895	10.613	8.1686	12.143	10.157	8.2491	9.5	12.019	10.385	8.20885
286	11.773	10.736	11.073	12.033	10.529	11.204	9.5	11.903	10.6325	11.1385
286	11.749	11.45	14.754	12.082	11.598	15.406	9.5	11.9155	11.524	15.08
286	12.52	12.751	19.198	12.592	13.347	19.343	9.5	12.556	13.049	19.2705
286	13.47	14.467	22.845	13.282	15.036	22.746	9.5	13.376	14.7515	22.7955
286	14.32	16.22	25.528	14.089	15.899	25.188	9.5	14.2045	16.0595	25.358
286	15.729	17.89	26.725	15.166	17.221	26.064	9.5	15.4475	17.5555	26.3945
286	16.561	19.111	26.484	16.061	18.464	25.577	9.5	16.311	18.7875	26.0305
286	17.497	19.707	25.039	16.831	19.119	22.857	9.5	17.164	19.413	23.948
286	18.058	19.758	20.469	17.398	18.913	19.124	9.5	17.728	19.3355	19.7965
286	17.78	18.992	17.34	17.36	18.025	16.436	9.5	17.57	18.5085	16.888
286	17.48	18.037	15.484	17.081	16.998	14.799	9.5	17.2805	17.5175	15.1415

286	17.002	17.077	14.322	16.681	16.114	13.815	9.5	16.8415	16.5955	14.0685
286	16.36	16.326	13.374	16.168	15.358	12.984	9.5	16.264	15.842	13.179
286	15.863	15.596	12.597	15.918	14.739	12.286	9.5	15.8905	15.1675	12.4415
286	15.554	15.069	12.134	15.454	14.232	11.877	9.5	15.504	14.6505	12.0055
286	15.205	14.573	11.606	15.197	13.819	11.399	9.5	15.201	14.196	11.5025
287	14.812	14.134	10.56	14.862	13.379	10.412	9.6	14.837	13.7565	10.486
287	14.327	13.64	10.531	14.469	12.88	10.405	9.6	14.398	13.26	10.468
287	14.005	13.238	9.9871	14.24	12.536	9.8815	9.6	14.1225	12.887	9.9343
287	13.764	12.904	9.6728	13.932	12.198	9.5925	9.6	13.848	12.551	9.63265
287	13.525	12.58	9.2276	13.684	11.907	9.1642	9.6	13.6045	12.2435	9.1959
287	13.181	12.214	8.2874	13.432	11.549	8.2832	9.6	13.3065	11.8815	8.2853
287	13.027	11.824	7.7964	13.153	11.129	7.8176	9.6	13.09	11.4765	7.807
287	12.604	11.38	8.4896	12.861	10.739	8.5574	9.6	12.7325	11.0595	8.5235
287	12.383	11.309	11.406	12.589	10.85	11.36	9.6	12.486	11.0795	11.383
287	12.43	11.968	14.963	12.506	11.892	15.477	9.6	12.468	11.93	15.22
287	13.011	13.095	16.033	13.154	13.41	16.104	9.6	13.0825	13.2525	16.0685
287	13.519	14.001	17.1	13.574	14.336	16.963	9.6	13.5465	14.1685	17.0315
287	14.133	14.735	18.175	14.011	15.011	17.929	9.6	14.072	14.873	18.052
287	14.616	15.377	17.873	14.604	15.753	17.57	9.6	14.61	15.565	17.7215
287	15.163	15.844	18.72	14.95	16.165	18.28	9.6	15.0565	16.0045	18.5
287	15.478	16.221	17.204	15.224	16.321	16.713	9.6	15.351	16.271	16.9585
287	15.488	16.035	14.903	15.346	15.951	14.556	9.6	15.417	15.993	14.7295
287	15.424	15.454	12.521	15.458	15.203	12.277	9.6	15.441	15.3285	12.399
287	14.991	14.635	10.779	15.116	14.233	10.598	9.6	15.0535	14.434	10.6885
287	14.69	13.835	9.5245	14.723	13.315	9.4019	9.6	14.7065	13.575	9.4632
287	14.09	13.07	8.5883	14.253	12.474	8.5078	9.6	14.1715	12.772	8.54805
287	13.596	12.404	7.8676	13.798	11.785	7.8252	9.6	13.697	12.0945	7.8464
287	13.055	11.819	7.1926	13.282	11.153	7.2053	9.6	13.1685	11.486	7.19895
287	12.566	11.253	6.7065	12.835	10.587	6.7193	9.6	12.7005	10.92	6.7129
288	12.025	10.752	6.2396	12.521	10.102	6.2949	9.6	12.273	10.427	6.26725
288	11.823	10.343	5.8554	12.135	9.6794	5.8724	9.6	11.979	10.0112	5.8639
288	11.448	9.9583	5.4846	11.819	9.2986	5.5357	9.6	11.6335	9.62845	5.51015
288	11.025	9.6268	5.3464	11.526	8.992	5.4018	9.6	11.2755	9.3094	5.3741
288	10.819	9.3143	5.0485	11.223	8.6877	5.0613	9.6	11.021	9.001	5.0549
288	10.607	9.1152	5.7772	10.911	8.4968	5.7645	9.6	10.759	8.806	5.77085
288	10.42	9.0753	5.9032	10.838	8.5628	5.9032	9.6	10.629	8.81905	5.9032
288	10.326	9.0232	6.9573	10.743	8.5742	6.9275	9.6	10.5345	8.7987	6.9424
288	10.377	9.2779	10.428	10.647	9.0536	10.542	9.6	10.512	9.16575	10.485
288	10.571	10.276	14.476	10.846	10.462	15.004	9.6	10.7085	10.369	14.74
288	11.37	11.758	18.472	11.577	12.447	18.567	9.6	11.4735	12.1025	18.5195
288	12.344	13.335	19.766	12.285	13.993	19.613	9.6	12.3145	13.664	19.6895
288	13.411	14.667	19.893	13.104	15.211	19.628	9.6	13.2575	14.939	19.7605
288	14.188	15.451	19.584	13.773	15.818	19.278	9.6	13.9805	15.6345	19.431
288	14.794	15.96	18.738	14.347	16.272	18.365	9.6	14.5705	16.116	18.5515
288	14.954	16.215	18.847	14.653	16.349	18.212	9.6	14.8035	16.282	18.5295
288	15.272	16.248	15.952	14.979	16.148	15.593	9.6	15.1255	16.198	15.7725
288	15.314	15.698	13.594	15.075	15.406	13.33	9.6	15.1945	15.552	13.462
288	14.863	14.98	11.998	14.746	14.528	11.83	9.6	14.8045	14.754	11.914
288	14.589	14.195	10.602	14.492	13.671	10.467	9.6	14.5405	13.933	10.5345
288	14.061	13.453	9.5455	14.028	12.853	9.4567	9.6	14.0445	13.153	9.5011
288	13.425	12.703	8.6791	13.593	12.093	8.6452	9.6	13.509	12.398	8.66215
288	13.118	12.063	8.2465	13.273	11.478	8.2338	9.6	13.1955	11.7705	8.24015
288	12.585	11.604	7.8426	12.824	11.01	7.8342	9.6	12.7045	11.307	7.8384
289	12.185	11.166	7.1589	12.53	10.559	7.1631	9.6	12.3575	10.8625	7.161
289	11.973	10.726	6.6427	12.175	10.092	6.6512	9.6	12.074	10.409	6.64695
289	11.611	10.342	6.1964	11.83	9.6829	6.2347	9.6	11.7205	10.01245	6.21555
289	11.265	9.906	5.646	11.551	9.2845	5.7099	9.6	11.408	9.59525	5.67795
289	10.932	9.5504	5.1205	11.197	8.8648	5.2101	9.6	11.0645	9.2076	5.1653
289	10.662	9.1274	4.6465	10.97	8.4624	4.7447	9.6	10.816	8.7949	4.6956
289	10.265	8.7383	4.4807	10.658	8.1025	4.5319	9.6	10.4615	8.4204	4.5063
289	9.8534	8.4311	5.8007	10.31	7.8798	5.9625	9.6	10.0817	8.15545	5.8816
289	9.7487	8.6653	8.4322	10.159	8.4238	8.6611	9.6	9.95385	8.54455	8.54665
289	9.9664	9.3873	12.137	10.3	9.4338	12.495	9.6	10.1332	9.41055	12.316
289	10.52	10.684	17.458	10.73	11.207	17.545	9.6	10.625	10.9455	17.5015
289	11.707	12.636	21.4	11.552	13.367	21.214	9.6	11.6295	13.0015	21.307
289	12.863	14.61	23.637	12.418	15.124	23.325	9.6	12.6405	14.867	23.481
289	13.986	16.222	24.735	13.224	16.697	24.198	9.6	13.605	16.4595	24.4665
289	15.127	17.432	24.184	14.153	17.677	23.441	9.6	14.64	17.5545	23.8125
289	15.751	18.082	22.283	14.824	17.688	19.918	9.6	15.2875	17.885	21.1005
289	16.213	18.143	18.467	15.232	17.017	16.413	9.6	15.7225	17.58	17.44

289	16.147	17.392	15.442	15.204	16.014	14.184	9.6	15.6755	16.703	14.813
289	15.811	16.403	13.418	14.909	14.988	12.508	9.6	15.36	15.6955	12.963
289	15.343	15.368	11.927	14.619	14.063	11.241	9.6	14.981	14.7155	11.584
289	14.763	14.511	10.748	14.248	13.263	10.199	9.6	14.5055	13.887	10.4735
289	14.12	13.705	9.6776	13.731	12.488	9.2379	9.6	13.9255	13.0965	9.45775
289	13.691	12.978	8.8089	13.339	11.805	8.4575	9.6	13.515	12.3915	8.6332
289	13.03	12.299	8.0983	12.892	11.158	7.8142	9.6	12.961	11.7285	7.95625
290	12.743	11.704	7.4595	12.57	10.642	7.243	9.7	12.6565	11.173	7.35125
290	12.323	11.161	6.8095	12.214	10.131	6.6394	9.7	12.2685	10.646	6.72445
290	11.861	10.643	6.1977	11.844	9.6419	6.0828	9.7	11.8525	10.14245	6.14025
290	11.395	10.167	5.7179	11.412	9.178	5.6454	9.7	11.4035	9.6725	5.68165
290	10.991	9.7031	5.3253	11.143	8.7678	5.2528	9.7	11.067	9.23545	5.28905
290	10.735	9.3445	4.8996	10.853	8.4127	4.8313	9.7	10.794	8.8786	4.86545
290	10.243	8.9441	4.449	10.53	8.0456	4.3892	9.7	10.3865	8.49485	4.4191
290	10.034	8.5615	5.5398	10.22	7.7472	5.5952	9.7	10.127	8.15435	5.5675
290	9.6696	8.6072	9.1535	9.9613	8.1367	9.2889	9.7	9.81545	8.37195	9.2212
290	9.9417	9.5614	12.827	10.094	9.4768	13.214	9.7	10.01785	9.5191	13.0205
290	10.64	10.935	17.742	10.632	11.361	17.784	9.7	10.636	11.148	17.763
290	11.751	12.794	21.26	11.541	13.503	21.029	9.7	11.646	13.1485	21.1445
290	12.911	14.724	24.756	12.407	15.213	24.239	9.7	12.659	14.9685	24.4975
290	14.206	16.514	25.449	13.402	16.914	24.823	9.7	13.804	16.714	25.136
290	15.119	17.814	24.877	14.292	17.893	23.968	9.7	14.7055	17.8535	24.4225
290	16.031	18.5	22.449	15.075	18.276	21.325	9.7	15.553	18.388	21.887
290	16.545	18.436	19.762	15.57	17.988	18.983	9.7	16.0575	18.212	19.3725
290	16.283	17.885	17.07	15.641	17.286	16.479	9.7	15.962	17.5855	16.7745
290	16.08	17.017	15.041	15.596	16.355	14.606	9.7	15.838	16.686	14.8235
290	15.84	16.224	13.867	15.218	15.452	13.506	9.7	15.529	15.838	13.6865
290	15.272	15.431	12.944	14.971	14.716	12.659	9.7	15.1215	15.0735	12.8015
290	14.815	14.794	11.416	14.522	14.003	11.205	9.7	14.6685	14.3985	11.3105
290	14.337	14.057	10.205	14.182	13.214	10.053	9.7	14.2595	13.6355	10.129
290	13.979	13.317	9.1972	13.803	12.481	9.1041	9.7	13.891	12.899	9.15065
291	13.38	12.595	8.316	13.33	11.737	8.244	9.7	13.355	12.166	8.28
291	12.881	11.977	7.8583	12.868	11.101	7.8116	9.7	12.8745	11.539	7.83495
291	12.522	11.491	7.7491	12.467	10.656	7.6769	9.7	12.4945	11.0735	7.713
291	12.1	11.055	7.421	12.18	10.279	7.3319	9.7	12.14	10.667	7.37645
291	11.931	10.734	7.017	11.927	9.9913	6.9745	9.7	11.929	10.36265	6.99575
291	11.467	10.447	7.0078	11.572	9.7202	6.9738	9.7	11.5195	10.0836	6.9908
291	11.294	10.171	6.4117	11.391	9.4318	6.3947	9.7	11.3425	9.8014	6.4032
291	10.893	9.8541	7.571	11.12	9.2113	7.5328	9.7	11.0065	9.5327	7.5519
291	10.941	9.9999	9.7549	11.021	9.5731	9.6746	9.7	10.981	9.7865	9.71475
291	10.973	10.568	13.32	11.007	10.425	13.371	9.7	10.99	10.4965	13.3455
291	11.464	11.696	17.001	11.393	11.932	16.939	9.7	11.4285	11.814	16.97
291	12.263	13.283	20.702	12.078	13.857	20.454	9.7	12.1705	13.57	20.578
291	13.242	14.72	22.273	12.99	15.372	21.795	9.7	13.116	15.046	22.034
291	14.503	16.095	22.602	13.93	16.741	22.075	9.7	14.2165	16.418	22.3385
291	15.093	16.878	22.7	14.675	17.456	22.041	9.7	14.884	17.167	22.3705
291	15.705	17.637	23.475	15.175	18.111	22.171	9.7	15.44	17.874	22.823
291	16.305	18.205	20.867	15.734	18.371	19.738	9.7	16.0195	18.288	20.3025
291	16.659	17.956	17.857	16.088	17.852	17.125	9.7	16.3735	17.904	17.491
291	16.599	17.335	15.761	15.944	16.965	15.218	9.7	16.2715	17.15	15.4895
291	16.209	16.53	14.426	15.675	16.063	14.007	9.7	15.942	16.2965	14.2165
291	15.641	15.762	13.47	15.412	15.299	13.135	9.7	15.5265	15.5305	13.3025
291	15.226	15.142	12.494	14.987	14.611	12.242	9.7	15.1065	14.8765	12.368
291	14.89	14.518	11.905	14.694	13.986	11.677	9.7	14.792	14.252	11.791
291	14.539	14.058	11.883	14.401	13.555	11.702	9.7	14.47	13.8065	11.7925
292	14.176	13.728	11.286	14.1	13.224	11.151	9.7	14.138	13.476	11.2185
292	13.781	13.349	11.18	13.823	12.862	11.058	9.7	13.802	13.1055	11.119
292	13.521	13.097	11.428	13.655	12.678	11.302	9.7	13.588	12.8875	11.365
292	13.379	12.989	11.555	13.43	12.586	11.437	9.7	13.4045	12.7875	11.496
292	13.256	12.924	11.65	13.306	12.55	11.541	9.7	13.281	12.737	11.5955
292	13.222	12.844	11.683	13.297	12.541	11.582	9.7	13.2595	12.6925	11.6325
292	13.284	12.813	11.724	13.254	12.536	11.615	9.7	13.269	12.6745	11.6695
292	13.091	12.818	11.969	13.154	12.537	11.847	9.7	13.1225	12.6775	11.908
292	13.205	12.835	12.348	13.171	12.625	12.23	9.7	13.188	12.73	12.289
292	13.218	12.916	12.606	13.206	12.748	12.484	9.7	13.212	12.832	12.545
292	13.228	13.047	13.165	13.148	12.896	13.031	9.7	13.188	12.9715	13.098
292	13.406	13.201	13.456	13.276	13.125	13.326	9.7	13.341	13.163	13.391
292	13.433	13.32	13.119	13.396	13.232	12.997	9.7	13.4145	13.276	13.058
292	13.315	13.373	13.503	13.369	13.285	13.394	9.7	13.342	13.329	13.4485
292	13.442	13.467	13.534	13.467	13.421	13.417	9.7	13.4545	13.444	13.4755

292	13.615	13.569	13.485	13.481	13.477	13.389	9.7	13.548	13.523	13.437
292	13.719	13.581	13.367	13.56	13.522	13.275	9.7	13.6395	13.5515	13.321
292	13.698	13.61	13.359	13.552	13.51	13.271	9.7	13.625	13.56	13.315
292	13.57	13.549	13.456	13.637	13.524	13.373	9.7	13.6035	13.5365	13.4145
292	13.57	13.595	13.595	13.616	13.566	13.503	9.7	13.593	13.5805	13.549
292	13.716	13.649	13.829	13.724	13.653	13.732	9.7	13.72	13.651	13.7805
292	13.633	13.801	14.58	13.638	13.784	14.513	9.7	13.6355	13.7925	14.5465
292	13.781	14.045	15.784	13.752	14.124	15.638	9.7	13.7665	14.0845	15.711
292	14.155	14.423	16.273	14.021	14.615	16.165	9.7	14.088	14.519	16.219
293	14.301	14.774	16.569	14.23	14.97	16.477	9.8	14.2655	14.872	16.523
293	14.512	15.056	16.733	14.445	15.256	16.624	9.8	14.4785	15.156	16.6785
293	14.696	15.261	16.641	14.6	15.444	16.52	9.8	14.648	15.3525	16.5805
293	14.887	15.409	16.54	14.691	15.551	16.427	9.8	14.789	15.48	16.4835
293	14.909	15.436	16.007	14.872	15.573	15.911	9.8	14.8905	15.5045	15.959
293	14.997	15.381	15.423	14.909	15.435	15.327	9.8	14.953	15.408	15.375
293	14.93	15.235	14.951	14.85	15.227	14.876	9.8	14.89	15.231	14.9135
293	15.011	15.036	14.723	14.869	15.02	14.664	9.8	14.94	15.028	14.6935
293	14.758	14.946	15.075	14.708	14.921	15.013	9.8	14.733	14.9335	15.044
293	14.713	14.922	16.195	14.708	14.959	16.124	9.8	14.7105	14.9405	16.1595
293	14.653	15.288	20.771	14.674	15.576	20.317	9.8	14.6635	15.432	20.544
293	15.408	16.555	24.643	15.153	17.279	24.287	9.8	15.2805	16.917	24.465
293	16.252	18.165	24.527	15.868	19.002	24.146	9.8	16.06	18.5835	24.3365
293	17.175	18.976	26.162	16.575	19.722	25.566	9.8	16.875	19.349	25.864
293	17.906	19.87	23.579	17.116	20.507	23.09	9.8	17.511	20.1885	23.3345
293	18.129	19.932	23.668	17.585	20.411	22.695	9.8	17.857	20.1715	23.1815
293	18.385	19.955	21.611	17.842	20.199	20.971	9.8	18.1135	20.077	21.291
293	18.398	19.587	19.802	17.912	19.636	19.293	9.8	18.155	19.6115	19.5475
293	18.175	19.004	18.349	17.789	18.922	17.947	9.8	17.982	18.963	18.148
293	17.871	18.377	16.285	17.459	18.124	16.085	9.8	17.665	18.2505	16.185
293	17.561	17.574	15.069	17.245	17.287	14.718	9.8	17.403	17.4305	14.8935
293	16.949	16.825	14.031	16.82	16.5	13.834	9.8	16.8845	16.6625	13.9325
293	16.42	16.165	13.091	16.361	15.765	12.982	9.8	16.3905	15.965	13.0365
293	15.969	15.505	12.339	16.019	15.109	12.259	9.8	15.994	15.307	12.299
294	15.483	14.936	11.736	15.538	14.509	11.698	9.8	15.5105	14.7225	11.717
294	15.088	14.436	12.006	15.218	14.03	11.964	9.8	15.153	14.233	11.985
294	14.81	14.157	11.836	14.852	13.768	11.79	9.8	14.831	13.9625	11.813
294	14.598	13.949	12.278	14.61	13.609	12.245	9.8	14.604	13.779	12.2615
294	14.403	13.862	12.667	14.436	13.598	12.625	9.8	14.4195	13.73	12.646
294	14.389	13.895	12.241	14.355	13.643	12.203	9.8	14.372	13.769	12.222
294	14.226	13.732	11.863	14.318	13.506	11.838	9.8	14.272	13.619	11.8505
294	14.182	13.545	12.475	14.191	13.273	12.488	9.8	14.1865	13.409	12.4815
294	13.766	13.624	15.331	13.959	13.552	15.469	9.8	13.8625	13.588	15.4
294	14.307	14.349	18.57	14.261	14.688	19.031	9.8	14.284	14.5185	18.8005
294	14.811	15.53	22.458	14.703	16.248	22.544	9.8	14.757	15.889	22.501
294	15.495	17.063	25.777	15.379	18.048	25.646	9.8	15.437	17.5555	25.7115
294	16.608	18.645	28.136	16.308	19.821	27.766	9.8	16.458	19.233	27.951
294	17.672	20.138	29.274	17.177	21.348	28.775	9.8	17.4245	20.743	29.0245
294	18.621	21.321	29.093	17.9	22.429	28.334	9.8	18.2605	21.875	28.7135
294	19.415	22.007	27.508	18.599	22.813	25.068	9.8	19.007	22.41	26.288
294	20.129	22.179	24.027	19.058	22.171	22.051	9.8	19.5935	22.175	23.039
294	20.169	21.522	21.131	19.105	21.16	19.925	9.8	19.637	21.341	20.528
294	19.651	20.601	19.195	18.864	20.126	18.341	9.8	19.2575	20.3635	18.768
294	19.283	19.788	17.79	18.4	19.187	17.137	9.8	18.8415	19.4875	17.4635
294	18.755	18.938	16.449	18.017	18.336	15.949	9.8	18.386	18.637	16.199
294	18.071	18.137	15.339	17.609	17.505	14.921	9.8	17.84	17.821	15.13
294	17.699	17.425	14.417	17.183	16.763	14.107	9.8	17.441	17.094	14.262
294	17.044	16.732	13.653	16.786	16.099	13.431	9.8	16.915	16.4155	13.542
295	16.749	16.132	13.087	16.466	15.539	12.902	9.8	16.6075	15.8355	12.9945
295	16.114	15.597	12.737	16.073	15.003	12.476	9.8	16.0935	15.3	12.6065
295	15.771	15.207	12.277	15.654	14.584	12.076	9.8	15.7125	14.8955	12.1765
295	15.444	14.808	11.813	15.377	14.202	11.662	9.8	15.4105	14.505	11.7375
295	15.26	14.416	11.49	15.164	13.833	11.376	9.8	15.212	14.1245	11.433
295	14.835	14.049	11.011	14.877	13.504	10.964	9.8	14.856	13.7765	10.9875
295	14.659	13.737	10.504	14.621	13.184	10.499	9.8	14.64	13.4605	10.5015
295	14.34	13.351	10.709	14.344	12.814	10.688	9.8	14.342	13.0825	10.6985
295	13.941	13.199	14.033	14.004	12.909	14.109	9.8	13.9725	13.054	14.071
295	14.054	13.932	18.2	13.974	14.054	18.602	9.8	14.014	13.993	18.401
295	14.498	15.263	23.247	14.398	15.885	23.284	9.8	14.448	15.574	23.2655
295	15.639	17.189	27.555	15.414	18.215	27.348	9.8	15.5265	17.702	27.4515
295	16.931	19.227	30.441	16.524	20.488	30.049	9.8	16.7275	19.8575	30.245

295	18.302	21.115	31.89	17.593	22.449	31.317	9.8	17.9475	21.782	31.6035
295	19.528	22.552	31.732	18.622	23.837	30.924	9.8	19.075	23.1945	31.328
295	20.505	23.423	30.076	19.513	24.399	27.559	9.8	20.009	23.911	28.8175
295	21.231	23.681	26.43	20.038	23.817	24.427	9.8	20.6345	23.749	25.4285
295	21.131	23.074	23.447	20.112	22.831	22.178	9.8	20.6215	22.9525	22.8125
295	21.051	22.238	21.327	19.969	21.826	20.345	9.8	20.51	22.032	20.836
295	20.585	21.365	19.527	19.577	20.792	18.79	9.8	20.081	21.0785	19.1585
295	20.048	20.432	18.225	19.204	19.837	17.602	9.8	19.626	20.1345	17.9135
295	19.508	19.582	17.18	18.836	18.998	16.714	9.8	19.172	19.29	16.947
295	18.958	18.838	16.215	18.407	18.241	15.848	9.8	18.6825	18.5395	16.0315
295	18.361	18.174	15.526	17.95	17.559	15.196	9.8	18.1555	17.8665	15.361
296	17.94	17.607	15.286	17.607	17.004	14.956	9.9	17.7735	17.3055	15.121
296	17.466	17.129	14.605	17.229	16.555	14.354	9.9	17.3475	16.842	14.4795
296	17.233	16.7	14.032	16.979	16.125	13.843	9.9	17.106	16.4125	13.9375
296	16.758	16.254	13.536	16.645	15.711	13.402	9.9	16.7015	15.9825	13.469
296	16.484	15.871	13.101	16.259	15.282	13.004	9.9	16.3715	15.5765	13.0525
296	16.211	15.464	13.107	16.082	14.979	13.01	9.9	16.1465	15.2215	13.0585
296	15.757	15.222	13.187	15.753	14.737	13.069	9.9	15.755	14.9795	13.128
296	15.583	15.09	13.499	15.541	14.639	13.39	9.9	15.562	14.8645	13.4445
296	15.548	15.017	14	15.481	14.67	13.887	9.9	15.5145	14.8435	13.9435
296	15.379	15.107	15.65	15.375	14.877	15.491	9.9	15.377	14.992	15.5705
296	15.668	15.506	17.223	15.518	15.485	17.048	9.9	15.593	15.4955	17.1355
296	15.972	16.093	18.826	15.743	16.239	18.639	9.9	15.8575	16.166	18.7325
296	16.232	16.649	18.619	16.061	16.832	18.437	9.9	16.1465	16.7405	18.528
296	16.654	16.991	18.425	16.367	17.183	18.276	9.9	16.5105	17.087	18.3505
296	16.84	17.193	18.519	16.552	17.36	18.361	9.9	16.696	17.2765	18.44
296	16.958	17.345	18.168	16.642	17.462	18.039	9.9	16.8	17.4035	18.1035
296	17.07	17.37	17.657	16.725	17.441	17.536	9.9	16.8975	17.4055	17.5965
296	17.105	17.313	17.163	16.751	17.297	17.005	9.9	16.928	17.305	17.084
296	16.998	17.16	17.268	16.727	17.135	17.093	9.9	16.8625	17.1475	17.1805
296	16.866	17.112	17.498	16.724	17.107	17.349	9.9	16.795	17.1095	17.4235
296	16.937	17.133	17.104	16.725	17.133	16.992	9.9	16.831	17.133	17.048
296	16.965	17.007	16.844	16.786	17.028	16.757	9.9	16.8755	17.0175	16.8005
296	16.89	16.927	16.019	16.698	16.852	15.969	9.9	16.794	16.8895	15.994
296	16.765	16.644	15.239	16.569	16.499	15.222	9.9	16.667	16.5715	15.2305
297	16.573	16.336	14.205	16.444	16.115	14.218	9.9	16.5085	16.2255	14.2115
297	16.2	15.904	13.126	16.266	15.586	13.122	9.9	16.233	15.745	13.124
297	15.975	15.332	12.53	15.992	15.002	12.539	9.9	15.9835	15.167	12.5345
297	15.497	14.895	11.859	15.61	14.477	11.884	9.9	15.5535	14.686	11.8715
297	15.165	14.421	11.52	15.316	14.023	11.331	9.9	15.2405	14.222	11.4255
297	14.859	14.059	11.308	15.051	13.67	11.19	9.9	14.955	13.8645	11.249
297	14.8	13.783	10.854	14.846	13.401	10.799	9.9	14.823	13.592	10.8265
297	14.436	13.535	11.227	14.553	13.12	11.177	9.9	14.4945	13.3275	11.202
297	14.163	13.37	11.992	14.385	13.085	11.921	9.9	14.274	13.2275	11.9565
297	14.044	13.525	14.254	14.208	13.382	14.158	9.9	14.126	13.4535	14.206
297	14.403	14.173	15.569	14.432	14.248	15.519	9.9	14.4175	14.2105	15.544
297	14.468	14.652	19.577	14.514	14.886	19.361	9.9	14.491	14.769	19.469
297	15.176	15.99	21.33	15.126	16.549	21.021	9.9	15.151	16.2695	21.1755
297	16.001	17.076	22.523	15.78	17.646	22.053	9.9	15.8905	17.361	22.288
297	16.829	18.109	21.989	16.437	18.682	21.532	9.9	16.633	18.3955	21.7605
297	17.355	18.361	18.979	16.922	18.647	18.672	9.9	17.1385	18.504	18.8255
297	17.378	17.91	16.983	17.116	17.993	16.745	9.9	17.247	17.9515	16.864
297	17.224	17.308	15.081	16.95	17.216	14.91	9.9	17.087	17.262	14.9955
297	16.715	16.523	13.283	16.719	16.302	13.19	9.9	16.717	16.4125	13.2365
297	16.185	15.747	12.535	16.314	15.421	12.451	9.9	16.2495	15.584	12.493
297	15.829	15.14	11.995	15.825	14.755	11.957	9.9	15.827	14.9475	11.976
297	15.191	14.597	11.229	15.387	14.161	11.204	9.9	15.289	14.379	11.2165
297	14.897	14.118	11.055	14.997	13.682	11.059	9.9	14.947	13.9	11.057
297	14.639	13.722	10.449	14.744	13.29	10.487	9.9	14.6915	13.506	10.468
298	14.213	13.328	10.378	14.447	12.904	10.425	9.9	14.33	13.116	10.4015
298	13.886	13.056	10.192	14.125	12.627	10.201	9.9	14.0055	12.8415	10.1965
298	13.804	12.813	10.05	13.925	12.406	10.113	9.9	13.8645	12.6095	10.0815
298	13.476	12.577	9.8757	13.673	12.194	9.9391	9.9	13.5745	12.3855	9.9074
298	13.393	12.406	9.7119	13.569	12.027	9.7795	9.9	13.481	12.2165	9.7457
298	13.078	12.221	9.5345	13.305	11.83	9.5599	9.9	13.1915	12.0255	9.5472
298	12.959	12.001	9.3597	13.27	11.647	9.3766	9.9	13.1145	11.824	9.36815
298	12.933	11.861	9.4181	13.084	11.499	9.4181	9.9	13.0085	11.68	9.4181
298	12.759	11.758	9.6273	12.922	11.425	9.6357	9.9	12.8405	11.5915	9.6315
298	12.695	11.774	10.501	12.838	11.526	10.506	9.9	12.7665	11.65	10.5035
298	12.495	12.163	16.818	12.718	12.319	16.793	9.9	12.6065	12.241	16.8055

298	13.174	13.698	20.438	13.208	14.222	20.318	9.9	13.191	13.96	20.378
298	14.108	15.341	23.379	13.99	16.151	23.108	9.9	14.049	15.746	23.2435
298	15.307	16.966	25.388	14.91	17.864	24.856	9.9	15.1085	17.415	25.122
298	16.373	18.398	25.066	15.864	19.318	24.365	9.9	16.1185	18.858	24.7155
298	17.288	19.126	22.511	16.647	19.656	20.438	9.9	16.9675	19.391	21.4745
298	17.555	19.024	18.817	17.064	18.8	17.114	9.9	17.3095	18.912	17.9655
298	17.663	18.223	15.647	17.014	17.667	14.624	9.9	17.3385	17.945	15.1355
298	16.976	17.163	13.521	16.53	16.397	12.77	9.9	16.753	16.78	13.1455
298	16.35	16.116	11.848	15.97	15.256	11.301	9.9	16.16	15.686	11.5745
298	15.847	15.133	10.514	15.555	14.267	10.117	9.9	15.701	14.7	10.3155
298	15.223	14.215	9.4514	15.006	13.343	9.1342	9.9	15.1145	13.779	9.2928
298	14.422	13.37	8.4453	14.426	12.496	8.208	9.9	14.424	12.933	8.32665
298	13.935	12.651	7.5912	13.948	11.759	7.4086	9.9	13.9415	12.205	7.4999
299	13.37	11.958	6.8317	13.404	11.078	6.717	10.0	13.387	11.518	6.77435
299	12.8	11.335	6.0988	12.871	10.428	6.0307	10.0	12.8355	10.8815	6.06475
299	12.326	10.721	5.4699	12.389	9.8253	5.4273	10.0	12.3575	10.27315	5.4486
299	11.874	10.162	4.9178	12.004	9.3032	4.8965	10.0	11.939	9.7326	4.90715
299	11.453	9.6378	4.3973	11.643	8.7998	4.4144	10.0	11.548	9.2188	4.40585
299	10.847	9.1691	3.8848	11.134	8.309	3.8976	10.0	10.9905	8.73905	3.8912
299	10.422	8.7215	3.3979	10.756	7.8648	3.4236	10.0	10.589	8.29315	3.41075
299	10.115	8.2686	3.8608	10.351	7.4495	3.9634	10.0	10.233	7.85905	3.9121
299	9.8259	8.1828	6.6111	10.084	7.5716	6.794	10.0	9.95495	7.8772	6.70255
299	9.7498	8.7256	10.54	10.012	8.535	10.995	10.0	9.8809	8.6303	10.7675
299	10.188	9.9808	15.309	10.382	10.259	15.443	10.0	10.285	10.1199	15.376
299	11.169	11.758	19.329	11.152	12.38	19.18	10.0	11.1605	12.069	19.2545
299	12.401	13.622	22.066	12.199	14.464	21.699	10.0	12.3	14.043	21.8825
299	13.698	15.317	23.496	13.292	16.264	22.958	10.0	13.495	15.7905	23.227
299	14.861	16.671	23.25	14.234	17.54	22.519	10.0	14.5475	17.1055	22.8845
299	15.69	17.41	21.405	15.139	17.996	19.037	10.0	15.4145	17.703	20.221
299	16.244	17.522	17.829	15.548	17.256	15.952	10.0	15.896	17.389	16.8905
299	16.044	16.828	14.968	15.548	16.236	13.78	10.0	15.796	16.532	14.374
299	15.793	15.944	12.915	15.242	15.201	12.092	10.0	15.5175	15.5725	12.5035
299	15.23	15.03	11.414	14.699	14.172	10.778	10.0	14.9645	14.601	11.096
299	14.587	14.16	10.98	14.239	13.322	10.47	10.0	14.413	13.741	10.725
299	14.064	13.561	10.356	13.859	12.768	9.9593	10.0	13.9615	13.1645	10.15765
299	13.637	13.012	9.9805	13.516	12.277	9.6426	10.0	13.5765	12.6445	9.81155
299	13.244	12.581	9.7445	13.236	11.899	9.4698	10.0	13.24	12.24	9.60715
300	13.094	12.262	9.8092	12.981	11.627	9.5556	10.0	13.0375	11.9445	9.6824
300	12.746	12.052	9.8983	12.721	11.484	9.6871	10.0	12.7335	11.768	9.7927
300	12.709	11.923	9.8442	12.579	11.388	9.671	10.0	12.644	11.6555	9.7576
300	12.527	11.812	9.919	12.451	11.307	9.7373	10.0	12.489	11.5595	9.82815
300	12.456	11.746	9.6451	12.292	11.236	9.5648	10.0	12.374	11.491	9.60495
300	12.364	11.573	9.3618	12.254	11.114	9.256	10.0	12.309	11.3435	9.3089
300	12.019	11.404	9.1456	12.094	10.919	9.0399	10.0	12.0565	11.1615	9.09275
300	11.937	11.255	9.1273	11.929	10.766	9.0173	10.0	11.933	11.0105	9.0723
300	11.905	11.13	9.2514	11.888	10.679	9.1668	10.0	11.8965	10.9045	9.2091
300	11.726	11.043	9.4476	11.818	10.664	9.3588	10.0	11.772	10.8535	9.4032
300	11.767	11.085	10.263	11.763	10.756	10.17	10.0	11.765	10.9205	10.2165
300	11.647	11.268	10.788	11.706	10.998	10.691	10.0	11.6765	11.133	10.7395
300	11.895	11.449	11.078	11.828	11.234	10.99	10.0	11.8615	11.3415	11.034
300	11.956	11.674	11.413	11.779	11.447	11.303	10.0	11.8675	11.5605	11.358
300	11.941	11.827	11.815	11.966	11.655	11.701	10.0	11.9535	11.741	11.758
300	12.215	12.039	12.115	12.064	11.879	12.001	10.0	12.1395	11.959	12.058
300	12.185	12.193	12.605	12.13	12.08	12.483	10.0	12.1575	12.1365	12.544
300	12.342	12.372	12.943	12.397	12.346	12.842	10.0	12.3695	12.359	12.8925
300	12.498	12.662	13.854	12.444	12.658	13.736	10.0	12.471	12.66	13.795
300	12.733	13.015	14.728	12.641	13.09	14.553	10.0	12.687	13.0525	14.6405
300	12.939	13.404	15.208	12.834	13.518	15.025	10.0	12.8865	13.461	15.1165
300	13.273	13.713	14.061	13.101	13.785	13.902	10.0	13.187	13.749	13.9815
300	13.39	13.679	13.906	13.273	13.65	13.713	10.0	13.3315	13.6645	13.8095
300	13.579	13.651	13.449	13.298	13.546	13.294	10.0	13.4385	13.5985	13.3715
301	13.462	13.524	12.908	13.315	13.411	12.782	10.0	13.3885	13.4675	12.845
301	13.46	13.334	11.393	13.326	13.108	11.313	10.0	13.393	13.221	11.353
301	13.324	12.913	10.726	13.139	12.577	10.645	10.0	13.2315	12.745	10.6855
301	13.001	12.526	10.329	12.917	12.148	10.27	10.0	12.959	12.337	10.2995
301	12.649	12.178	9.9828	12.682	11.812	9.9026	10.0	12.6655	11.995	9.9427
301	12.605	12.02	10.441	12.596	11.675	10.356	10.0	12.6005	11.8475	10.3985
301	12.328	11.873	9.0429	12.449	11.474	9.0344	10.0	12.3885	11.6735	9.03865
301	12.179	11.404	8.7318	12.326	10.97	8.5371	10.0	12.2525	11.187	8.63445
301	11.858	11.251	10.459	11.912	10.952	10.421	10.0	11.885	11.1015	10.44

301	11.98	11.504	12.464	12.094	11.555	12.724	10.0	12.037	11.5295	12.594
301	12.067	12.172	15.696	12.147	12.403	15.642	10.0	12.107	12.2875	15.669
301	12.741	13.186	19.45	12.628	13.732	19.218	10.0	12.6845	13.459	19.334
301	13.407	14.559	21.44	13.268	15.349	21.127	10.0	13.3375	14.954	21.2835
301	14.309	15.697	20.785	14.049	16.473	20.437	10.0	14.179	16.085	20.611
301	14.884	16.391	21.038	14.621	17.087	20.605	10.0	14.7525	16.739	20.8215
301	15.434	16.715	18.44	15.142	17.16	16.977	10.0	15.288	16.9375	17.7085
301	15.779	16.492	14.726	15.24	16.255	13.587	10.0	15.5095	16.3735	14.1565
301	15.474	15.54	11.747	15.11	14.985	11.077	10.0	15.292	15.2625	11.412
301	14.72	14.381	9.8431	14.578	13.682	9.3908	10.0	14.649	14.0315	9.61695
301	13.955	13.355	8.4892	13.934	12.544	8.1671	10.0	13.9445	12.9495	8.32815
301	13.254	12.38	7.3388	13.321	11.555	7.0967	10.0	13.2875	11.9675	7.21775
301	12.576	11.561	6.4477	12.714	10.697	6.2775	10.0	12.645	11.129	6.3626
301	12.037	10.815	5.6633	12.218	9.9622	5.5482	10.0	12.1275	10.3886	5.60575
301	11.534	10.125	4.9702	11.766	9.3172	4.9062	10.0	11.65	9.7211	4.9382
302	11.074	9.5447	4.3289	11.204	8.698	4.3075	10.1	11.139	9.12135	4.3182
302	10.585	8.9611	4.2483	10.838	8.1602	4.2227	10.1	10.7115	8.56065	4.2355
302	10.271	8.5873	3.9308	10.482	7.824	3.9137	10.1	10.3765	8.20565	3.92225
302	9.8425	8.2418	3.646	10.121	7.4991	3.6375	10.1	9.98175	7.87045	3.64175
302	9.5197	7.8883	2.9553	9.727	7.1154	2.9853	10.1	9.62335	7.50185	2.9703
302	9.2258	7.4618	2.7305	9.4966	6.7137	2.7733	10.1	9.3612	7.08775	2.7519
302	8.7376	7.1716	3.1658	9.0934	6.4529	3.1787	10.1	8.9155	6.81225	3.17225
302	8.5497	7.0003	3.4088	8.8803	6.3623	3.5072	10.1	8.715	6.6813	3.458
302	8.4284	7.0019	5.7122	8.7166	6.517	5.8954	10.1	8.5725	6.75945	5.8038
302	8.4354	7.5063	8.8336	8.7193	7.4002	9.2189	10.1	8.57735	7.45325	9.02625
302	8.9955	8.4024	9.4567	9.1817	8.4956	9.5794	10.1	9.0886	8.449	9.51805
302	9.3851	9.1101	10.682	9.5162	9.2286	10.631	10.1	9.45065	9.16935	10.6565
302	9.7351	9.7097	12.664	9.8576	9.883	12.492	10.1	9.79635	9.79635	12.578
302	10.311	10.666	15.62	10.261	11.083	15.269	10.1	10.286	10.8745	15.4445
302	11.173	11.808	15.063	10.958	12.263	14.499	10.1	11.0655	12.0355	14.781
302	11.65	12.259	13.293	11.544	12.432	11.742	10.1	11.597	12.3455	12.5175
302	12.071	12.155	10.048	11.734	11.751	9.1014	10.1	11.9025	11.953	9.5747
302	11.661	11.505	8.0699	11.513	10.852	7.4549	10.1	11.587	11.1785	7.7624
302	11.41	10.711	6.6027	11.204	9.9424	6.1774	10.1	11.307	10.3267	6.39005
302	10.95	9.9199	5.6772	10.836	9.1503	5.3534	10.1	10.893	9.5351	5.5153
302	10.308	9.2596	4.9553	10.329	8.455	4.7206	10.1	10.3185	8.8573	4.83795
302	9.9661	8.7093	4.4044	9.9196	7.9207	4.2336	10.1	9.94285	8.315	4.319
302	9.4017	8.2326	4.8293	9.5963	7.5155	4.6799	10.1	9.499	7.87405	4.7546
302	9.1567	8.055	5.1456	9.2752	7.3928	5.0091	10.1	9.21595	7.7239	5.07735
303	9.1373	7.9422	5.1771	9.1881	7.3521	5.0662	10.1	9.1627	7.64715	5.12165
303	8.9588	7.8567	5.0784	9.0054	7.275	4.9632	10.1	8.9821	7.56585	5.0208
303	8.7307	7.7045	4.5541	8.8832	7.1014	4.4901	10.1	8.80695	7.40295	4.5221
303	8.7593	7.5082	4.254	8.789	6.9218	4.2326	10.1	8.77415	7.215	4.2433
303	8.5428	7.2911	3.3556	8.6318	6.679	3.3428	10.1	8.5873	6.98505	3.3492
303	8.3021	6.9096	2.3673	8.4293	6.229	2.3931	10.1	8.3657	6.5693	2.3802
303	7.9807	6.4426	1.6644	8.1164	5.723	1.673	10.1	8.04855	6.0828	1.6687
303	7.4754	5.957	1.8698	7.7641	5.2367	1.8998	10.1	7.61975	5.59685	1.8848
303	7.0682	5.7832	4.8024	7.4124	5.2631	4.8749	10.1	7.2403	5.52315	4.83865
303	7.4197	6.4378	8.9462	7.4664	6.3782	9.2637	10.1	7.44305	6.408	9.10495
303	7.9426	7.8323	12.503	7.9892	8.1588	12.524	10.1	7.9659	7.99555	12.5135
303	8.7419	9.0635	13.428	8.7249	9.4652	13.218	10.1	8.7334	9.26435	13.323
303	9.546	10.306	15.613	9.3219	10.888	15.325	10.1	9.43395	10.597	15.469
303	10.242	11.502	17.291	10.086	12.138	16.787	10.1	10.164	11.82	17.039
303	11.309	12.5	17.478	10.964	13.129	16.77	10.1	11.1365	12.8145	17.124
303	11.785	13.155	15.924	11.516	13.452	13.788	10.1	11.6505	13.3035	14.856
303	12.259	13.182	12.7	11.876	12.788	11.064	10.1	12.0675	12.985	11.882
303	12.31	12.642	10.142	11.684	11.89	9.1236	10.1	11.997	12.266	9.6328
303	12.076	11.799	8.3033	11.475	10.944	7.5573	10.1	11.7755	11.3715	7.9303
303	11.268	10.906	6.8725	11.032	9.9903	6.3071	10.1	11.15	10.44815	6.5898
303	10.887	10.056	5.7213	10.685	9.1512	5.2569	10.1	10.786	9.6036	5.4891
303	10.471	9.2966	4.7929	10.222	8.382	4.4258	10.1	10.3465	8.8393	4.60935
303	9.8824	8.6256	4.0255	9.7387	7.7138	3.7476	10.1	9.81055	8.1697	3.88655
303	9.3052	8.0256	3.3515	9.2544	7.1043	3.1418	10.1	9.2798	7.56495	3.24665
304	8.9123	7.4747	2.8943	8.8953	6.5736	2.7015	10.1	8.9038	7.02415	2.7979
304	8.3469	6.9756	2.3776	8.4698	6.0992	2.2404	10.1	8.40835	6.5374	2.309
304	8.0957	6.5618	2.041	8.172	5.6973	1.9209	10.1	8.13385	6.12955	1.98095
304	7.6858	6.1677	1.6563	7.8344	5.3153	1.5619	10.1	7.7601	5.7415	1.6091
304	7.4706	5.8198	1.413	7.547	4.9968	1.3228	10.1	7.5088	5.4083	1.3679
304	7.0582	5.5298	1.4042	7.2962	4.732	1.314	10.1	7.1772	5.1309	1.3591
304	6.9578	5.3052	0.83795	7.0343	4.4942	0.78204	10.1	6.99605	4.8997	0.809995

304	6.4914	4.9697	1.0329	6.6702	4.1709	1.0286	10.1	6.5808	4.5703	1.03075
304	6.239	4.8406	3.6439	6.4987	4.2682	3.7038	10.1	6.36885	4.5544	3.67385
304	6.2017	5.388	7.3712	6.4571	5.2003	7.6684	10.1	6.3294	5.29415	7.5198
304	6.7452	6.6389	11.868	6.9237	6.8854	11.906	10.1	6.83445	6.76215	11.887
304	7.598	8.323	15.755	7.6277	8.8649	15.554	10.1	7.61285	8.59395	15.6545
304	9.0388	10.179	18.507	8.7173	10.976	18.076	10.1	8.87805	10.5775	18.2915
304	10.107	11.884	19.843	9.7647	12.754	19.301	10.1	9.93585	12.319	19.572
304	11.448	13.199	19.773	10.812	14.016	18.99	10.1	11.13	13.6075	19.3815
304	12.137	13.945	18.258	11.696	14.526	16.308	10.1	11.9165	14.2355	17.283
304	12.706	14.151	15.276	12.172	14.143	13.904	10.1	12.439	14.147	14.59
304	12.877	13.682	12.957	12.222	13.389	12.071	10.1	12.5495	13.5355	12.514
304	12.51	12.968	11.56	12.107	12.59	10.912	10.1	12.3085	12.779	11.236
304	12.177	12.354	10.531	11.891	11.933	10.016	10.1	12.034	12.1435	10.2735
304	11.891	11.811	10.138	11.516	11.331	9.6992	10.1	11.7035	11.571	9.9186
304	11.562	11.411	9.665	11.217	10.935	9.3142	10.1	11.3895	11.173	9.4896
304	11.313	11.065	9.508	11.031	10.614	9.1868	10.1	11.172	10.8395	9.3474
304	11.189	10.813	9.7923	10.923	10.442	9.505	10.1	11.056	10.6275	9.64865
305	10.919	10.758	10.075	10.746	10.4	9.7919	10.2	10.8325	10.579	9.93345
305	10.964	10.724	10.066	10.753	10.407	9.8037	10.2	10.8585	10.5655	9.93485
305	10.793	10.663	9.8186	10.65	10.342	9.5735	10.2	10.7215	10.5025	9.69605
305	10.861	10.617	10.089	10.692	10.313	9.8526	10.2	10.7765	10.465	9.9708
305	10.739	10.604	10.203	10.651	10.343	9.9754	10.2	10.695	10.4735	10.0892
305	10.701	10.613	10.14	10.655	10.381	9.9205	10.2	10.678	10.497	10.03025
305	10.794	10.613	10.191	10.743	10.414	10.001	10.2	10.7685	10.5135	10.096
305	10.769	10.618	10.158	10.731	10.436	9.9762	10.2	10.75	10.527	10.0671
305	10.873	10.67	10.552	10.603	10.468	10.375	10.2	10.738	10.569	10.4635
305	10.777	10.782	11.502	10.63	10.655	11.321	10.2	10.7035	10.7185	11.4115
305	11.027	11.031	11.843	10.841	11.022	11.637	10.2	10.934	11.0265	11.74
305	11.144	11.312	12.65	11.017	11.371	12.431	10.2	11.0805	11.3415	12.5405
305	11.357	11.673	12.11	11.121	11.677	11.912	10.2	11.239	11.675	12.011
305	11.364	11.578	10.407	11.334	11.469	10.259	10.2	11.349	11.5235	10.333
305	11.268	11.226	9.7199	11.184	11.011	9.5973	10.2	11.226	11.1185	9.6586
305	11.218	10.944	9.7712	11.008	10.653	9.6445	10.2	11.113	10.7985	9.70785
305	11.16	10.78	9.2178	10.983	10.485	8.9174	10.2	11.0715	10.6325	9.0676
305	10.947	10.496	7.5387	10.8	10.049	7.3732	10.2	10.8735	10.2725	7.45595
305	10.642	9.9582	6.836	10.541	9.4426	6.6915	10.2	10.5915	9.7004	6.76375
305	10.351	9.4644	5.9731	10.242	8.9144	5.7858	10.2	10.2965	9.1894	5.87945
305	9.8355	8.9177	5.5118	10	8.3798	5.2434	10.2	9.91775	8.64875	5.3776
305	9.4619	8.4925	4.9043	9.631	7.9329	4.5971	10.2	9.54645	8.2127	4.7507
305	9.0995	8.1209	4.372	9.2518	7.5014	4.12	10.2	9.17565	7.81115	4.246
305	8.8484	7.691	3.7423	9.0262	7.0838	3.5884	10.2	8.9373	7.3874	3.66535
306	8.5371	7.2982	3.1533	8.6727	6.6479	3.0762	10.2	8.6049	6.97305	3.11475
306	8.2803	6.9004	2.7437	8.3523	6.2241	2.6409	10.2	8.3163	6.56225	2.6923
306	7.8549	6.4868	2.3655	8.0925	5.8269	2.2883	10.2	7.9737	6.15685	2.3269
306	7.5155	6.1719	1.9624	7.7702	5.4861	1.8766	10.2	7.64285	5.829	1.9195
306	7.3691	5.8549	1.6131	7.488	5.1346	1.5272	10.2	7.42855	5.49475	1.57015
306	6.9421	5.5246	1.2453	7.2354	4.8122	1.1851	10.2	7.08875	5.1684	1.2152
306	6.6218	5.2247	1.0244	6.9408	4.5119	0.94707	10.2	6.7813	4.8683	0.985735
306	6.3215	4.9192	1.2967	6.6831	4.2402	1.3139	10.2	6.5023	4.5797	1.3053
306	6.2627	4.8775	3.865	6.4287	4.3907	3.9848	10.2	6.3457	4.6341	3.9249
306	6.4726	5.4506	7.3822	6.5832	5.3867	7.7346	10.2	6.5279	5.41865	7.5584
306	6.9611	6.6423	11.206	7.0163	6.9526	11.353	10.2	6.9887	6.79745	11.2795
306	7.6178	8.1139	14.533	7.6687	8.7239	14.437	10.2	7.64325	8.4189	14.485
306	8.8236	9.7452	16.909	8.5485	10.509	16.601	10.2	8.68605	10.1271	16.755
306	9.8773	11.197	18.157	9.4929	12.018	17.583	10.2	9.6851	11.6075	17.87
306	10.669	12.285	17.863	10.39	13.061	17.102	10.2	10.5295	12.673	17.4825
306	11.45	12.962	16.333	11.113	13.419	14.027	10.2	11.2815	13.1905	15.18
306	11.919	13.107	12.805	11.372	12.73	11.073	10.2	11.6455	12.9185	11.939
306	11.777	12.416	9.9443	11.281	11.689	8.8245	10.2	11.529	12.0525	9.3844
306	11.443	11.443	7.8565	11.022	10.622	7.0376	10.2	11.2325	11.0325	7.44705
306	10.881	10.451	6.1842	10.569	9.5512	5.5755	10.2	10.725	10.0011	5.87985
306	10.2	9.5241	4.9164	10.027	8.5719	4.4427	10.2	10.1135	9.048	4.67955
306	9.7294	8.6969	3.9141	9.4841	7.7302	3.5422	10.2	9.60675	8.21355	3.72815
306	9.0431	7.9326	3.4931	9.0007	6.9814	3.185	10.2	9.0219	7.457	3.33905
306	8.5489	7.361	3.2508	8.5235	6.4768	2.9726	10.2	8.5362	6.9189	3.1117
307	8.1555	6.9453	2.9257	8.1639	6.0858	2.6986	10.2	8.1597	6.51555	2.81215
307	7.8655	6.5736	2.6408	7.823	5.7348	2.4436	10.2	7.84425	6.1542	2.5422
307	7.5006	6.2248	2.465	7.5686	5.4323	2.2935	10.2	7.5346	5.82855	2.37925
307	7.3573	5.9491	2.2473	7.3701	5.186	2.08	10.2	7.3637	5.56755	2.16365
307	6.9836	5.7108	2.136	7.0814	4.9601	1.9944	10.2	7.0325	5.33545	2.0652

307	6.7016	5.5092	2.0661	6.8463	4.7668	1.9288	10.2	6.77395	5.138	1.99745
307	6.5686	5.2904	1.9445	6.7175	4.6075	1.833	10.2	6.64305	4.94895	1.88875
307	6.561	5.1549	2.0487	6.5822	4.5017	1.9328	10.2	6.5716	4.8283	1.99075
307	6.2295	5.07	2.7479	6.421	4.4723	2.6279	10.2	6.32525	4.77115	2.6879
307	6.3111	5.1989	4.0032	6.4005	4.7124	3.8664	10.2	6.3558	4.95565	3.9348
307	6.4379	5.4966	4.797	6.472	5.1299	4.6348	10.2	6.45495	5.31325	4.7159
307	6.6151	5.8744	5.4226	6.479	5.5548	5.2605	10.2	6.54705	5.7146	5.34155
307	6.6003	6.1833	5.9491	6.6726	5.9192	5.7829	10.2	6.63645	6.05125	5.866
307	7.1437	6.4507	5.7951	6.9822	6.2337	5.6247	10.2	7.06295	6.3422	5.7099
307	6.9201	6.5843	5.6393	7.0221	6.3333	5.4944	10.2	6.9711	6.4588	5.56685
307	7.3302	6.6247	4.9849	7.1815	6.3439	4.8526	10.2	7.25585	6.4843	4.91875
307	7.2542	6.5018	4.5927	7.1735	6.1656	4.4646	10.2	7.21385	6.3337	4.52865
307	7.2186	6.381	4.5185	7.1378	6.0107	4.3776	10.2	7.1782	6.19585	4.44805
307	6.8637	6.2811	4.5079	6.953	5.9022	4.3756	10.2	6.90835	6.09165	4.44175
307	6.8315	6.219	4.5694	6.9208	5.8401	4.4583	10.2	6.87615	6.02955	4.51385
307	6.9326	6.1925	4.5898	6.8986	5.8264	4.4788	10.2	6.9156	6.00945	4.5343
307	6.8224	6.163	4.4535	6.9286	5.8139	4.3552	10.2	6.8755	5.98845	4.40435
307	6.8308	6.1119	4.6413	6.8691	5.767	4.5303	10.2	6.84995	5.93945	4.5858
307	6.7012	6.1481	4.7886	6.765	5.8033	4.6947	10.2	6.7331	5.9757	4.74165
308	6.7352	6.1779	4.6093	6.867	5.8416	4.5154	10.3	6.8011	6.00975	4.56235
308	6.7374	6.1716	4.398	6.7459	5.7969	4.3083	10.3	6.74165	5.98425	4.35315
308	6.8949	6.125	4.2402	6.7886	5.7332	4.159	10.3	6.84175	5.9291	4.1996
308	6.663	5.9948	4.3016	6.6927	5.6242	4.2461	10.3	6.67785	5.8095	4.27385
308	6.6799	5.9138	4.293	6.7054	5.5815	4.2374	10.3	6.69265	5.74765	4.2652
308	6.4933	5.9144	4.1483	6.6974	5.5736	4.1013	10.3	6.59535	5.744	4.1248
308	6.6496	5.8452	3.6856	6.6454	5.4915	3.6385	10.3	6.6475	5.66835	3.66205
308	6.3953	5.6117	2.9888	6.557	5.1939	2.9674	10.3	6.47615	5.4028	2.9781
308	6.2223	5.4258	4.9396	6.4351	5.1145	4.8201	10.3	6.3287	5.27015	4.87985
308	6.4493	5.8151	8.0718	6.4025	5.8491	8.2711	10.3	6.4259	5.8321	8.17145
308	6.5312	6.8585	11.491	6.697	7.2027	11.584	10.3	6.6141	7.0306	11.5375
308	7.3217	8.2166	14.672	7.3217	8.8222	14.513	10.3	7.3217	8.5194	14.5925
308	8.2971	9.575	16.768	8.1573	10.365	16.484	10.3	8.2272	9.97	16.626
308	9.3494	10.919	17.638	9.0746	11.774	17.127	10.3	9.212	11.3465	17.3825
308	10.103	11.94	17.169	9.7991	12.671	16.407	10.3	9.95105	12.3055	16.788
308	11.054	12.459	15.107	10.51	12.853	13.139	10.3	10.782	12.656	14.123
308	11.315	12.303	11.748	10.746	12.013	10.396	10.3	11.0305	12.158	11.072
308	10.988	11.531	9.287	10.6	11.005	8.4112	10.3	10.794	11.268	8.8491
308	10.779	10.677	7.5858	10.298	10.019	6.9364	10.3	10.5385	10.348	7.2611
308	10.037	9.8299	6.3966	9.7919	9.0901	5.9031	10.3	9.91445	9.46	6.14985
308	9.6298	9.08	5.4239	9.3254	8.3135	5.0105	10.3	9.4776	8.69675	5.2172
308	9.1276	8.378	4.6269	8.9075	7.5934	4.3067	10.3	9.01755	7.9857	4.4668
308	8.7227	7.7645	4.4442	8.5617	7.0299	4.1494	10.3	8.6422	7.3972	4.2968
308	8.3102	7.3385	4.1988	8.2127	6.6414	3.9681	10.3	8.26145	6.98995	4.08345
309	7.8453	7.0086	3.8583	7.8326	6.3324	3.653	10.3	7.83895	6.6705	3.75565
309	7.6671	6.6941	3.6746	7.6799	6.043	3.4992	10.3	7.6735	6.36855	3.5869
309	7.2961	6.4458	3.7244	7.3981	5.8158	3.5533	10.3	7.3471	6.1308	3.63885
309	7.2776	6.2655	3.3806	7.2521	5.6651	3.2137	10.3	7.26485	5.9653	3.29715
309	7.0802	6.0039	2.715	7.0972	5.3861	2.5822	10.3	7.0887	5.695	2.6486
309	6.6943	5.7025	2.2703	6.8262	5.0545	2.1545	10.3	6.76025	5.3785	2.2124
309	6.6244	5.3937	1.8006	6.6541	4.758	1.7019	10.3	6.63925	5.07585	1.75125
309	6.4362	5.0642	1.3526	6.4107	4.4025	1.271	10.3	6.42345	4.73335	1.3118
309	6.0481	4.7775	3.6408	6.129	4.2479	3.6622	10.3	6.08855	4.5127	3.6515
309	5.8422	5.1772	6.8337	5.9784	5.0023	6.9995	10.3	5.9103	5.08975	6.9166
309	6.4184	6.2609	10.642	6.3758	6.4822	10.617	10.3	6.3971	6.37155	10.6295
309	7.2286	7.7166	14.773	7.0036	8.2465	14.53	10.3	7.1161	7.98155	14.6515
309	8.2515	9.4108	17.075	7.8277	10.129	16.646	10.3	8.0396	9.7699	16.8605
309	9.201	10.906	18.098	8.8373	11.714	17.524	10.3	9.01915	11.31	17.811
309	10.315	12.05	17.622	9.6867	12.756	16.84	10.3	10.00085	12.403	17.231
309	10.907	12.576	15.406	10.473	12.966	13.398	10.3	10.69	12.771	14.402
309	11.3	12.461	11.75	10.736	12.188	10.517	10.3	11.018	12.3245	11.1335
309	11.09	11.65	9.1238	10.623	11.12	8.324	10.3	10.8565	11.385	8.7239
309	10.829	10.699	7.722	10.391	10.078	7.1196	10.3	10.61	10.3885	7.4208
309	10.217	9.8793	6.1447	9.8243	9.1522	5.7191	10.3	10.02065	9.51575	5.9319
309	9.7191	8.9959	4.9428	9.4739	8.2674	4.5973	10.3	9.5965	8.63165	4.77005
309	9.1693	8.2205	4.0411	9.0127	7.4739	3.7676	10.3	9.091	7.8472	3.90435
309	8.643	7.536	3.2644	8.5328	6.7796	3.059	10.3	8.5879	7.1578	3.1617
309	8.0512	6.9174	2.5595	8.0554	6.1474	2.4009	10.3	8.0533	6.5324	2.4802
310	7.469	6.4105	3.0727	7.5752	5.6782	2.9057	10.3	7.5221	6.04435	2.9892
310	7.1854	6.1645	3.3643	7.3086	5.5383	3.2145	10.3	7.247	5.8514	3.2894
310	7.0216	6.0217	3.4519	7.1576	5.4636	3.3021	10.3	7.0896	5.74265	3.377

310	6.8474	5.9238	3.5673	7.0005	5.3911	3.4004	10.3	6.92395	5.65745	3.48385
310	6.8414	5.8794	3.6383	6.8584	5.3595	3.4885	10.3	6.8499	5.61945	3.5634
310	6.8108	5.8106	3.7874	6.798	5.3289	3.6463	10.3	6.8044	5.56975	3.71685
310	6.7423	5.7931	3.8126	6.7253	5.337	3.7056	10.3	6.7338	5.56505	3.7591
310	6.6853	5.7743	4.0717	6.6682	5.3609	3.9691	10.3	6.67675	5.5676	4.0204
310	6.4904	5.8092	4.6578	6.6563	5.4768	4.551	10.3	6.57335	5.643	4.6044
310	6.6672	5.9735	5.104	6.6842	5.6966	4.9973	10.3	6.6757	5.83505	5.05065
310	6.7875	6.1493	5.6979	6.7832	5.9237	5.5701	10.3	6.78535	6.0365	5.634
310	6.9023	6.3622	5.8471	6.8513	6.175	5.7108	10.3	6.8768	6.2686	5.77895
310	6.9823	6.5444	5.8932	6.9313	6.3359	5.7612	10.3	6.9568	6.44015	5.8272
310	6.953	6.6384	5.9789	6.9573	6.4215	5.8724	10.3	6.95515	6.52995	5.92565
310	7.0871	6.662	6.1983	7.1211	6.5132	6.0748	10.3	7.1041	6.5876	6.13655
310	7.1708	6.8096	6.4906	7.0986	6.648	6.3843	10.3	7.1347	6.7288	6.43745
310	7.0703	6.9344	6.9811	7.1298	6.8068	6.8408	10.3	7.10005	6.8706	6.91095
310	7.3866	7.1446	7.1064	7.2635	7.0426	6.9789	10.3	7.32505	7.0936	7.04265
310	7.409	7.358	6.6528	7.4344	7.2434	6.538	10.3	7.4217	7.3007	6.5954
310	7.3409	7.2475	5.9422	7.4301	7.0309	5.8613	10.3	7.3855	7.1392	5.90175
310	7.3349	7.1014	5.5615	7.3901	6.8379	5.5061	10.3	7.3625	6.96965	5.5338
310	7.2815	6.827	3.9205	7.3495	6.4826	3.8778	10.3	7.3155	6.6548	3.89915
310	7.1643	6.3309	2.9503	7.2025	5.8925	2.9161	10.3	7.1834	6.1117	2.9332
310	6.7429	5.8705	2.294	6.8959	5.372	2.3069	10.3	6.8194	5.62125	2.30045
311	6.4571	5.4136	1.7908	6.5762	4.8805	1.8079	10.4	6.51665	5.14705	1.79935
311	6.1067	5.0156	1.4717	6.2684	4.4564	1.4803	10.4	6.18755	4.736	1.476
311	5.8051	4.675	1.5026	5.9797	4.1283	1.5069	10.4	5.8924	4.40165	1.50475
311	5.5376	4.4624	1.4734	5.8273	3.9582	1.4777	10.4	5.68245	4.2103	1.47555
311	5.3761	4.3219	1.3618	5.6575	3.8304	1.3618	10.4	5.5168	4.07615	1.3618
311	5.3016	4.166	0.86555	5.4295	3.6359	0.86555	10.4	5.36555	3.90095	0.86555
311	5.1761	3.9463	0.54992	5.2956	3.3988	0.59723	10.4	5.23585	3.67255	0.573575
311	4.8652	3.7159	0.95041	5.0828	3.1725	0.90312	10.4	4.974	3.4442	0.926765
311	4.8639	3.6761	2.104	5.0133	3.2525	2.0654	10.4	4.9386	3.4643	2.0847
311	4.7783	3.8939	3.2222	4.9148	3.5646	3.1409	10.4	4.84655	3.72925	3.18155
311	4.9418	4.2927	5.2276	5.0314	4.1432	4.9972	10.4	4.9866	4.21795	5.1124
311	5.1564	4.9559	7.4972	5.2716	4.9645	7.1743	10.4	5.214	4.9602	7.33575
311	5.6694	5.9462	11.436	5.6694	6.2996	11.179	10.4	5.6694	6.1229	11.3075
311	6.6697	7.3282	12.398	6.4145	7.7314	11.982	10.4	6.5421	7.5298	12.19
311	7.2965	8.1702	10.12	7.1054	8.4328	9.8287	10.4	7.20095	8.3015	9.97435
311	7.9402	8.5589	9.6714	7.6773	8.6266	8.8256	10.4	7.80875	8.59275	9.2485
311	8.0563	8.408	7.7213	7.6789	8.2047	7.1611	10.4	7.8676	8.30635	7.4412
311	7.9818	8.003	5.3931	7.6721	7.5958	5.0223	10.4	7.82695	7.7994	5.2077
311	7.7682	7.2716	4.0048	7.5263	6.7661	3.6929	10.4	7.64725	7.01885	3.84885
311	7.2016	6.5768	4.049	7.2185	6.0747	3.7798	10.4	7.21005	6.32575	3.9144
311	6.8663	6.2326	4.0021	6.9258	5.777	3.7713	10.4	6.89605	6.0048	3.8867
311	6.6725	5.9618	3.5976	6.7193	5.506	3.3837	10.4	6.6959	5.7339	3.49065
311	6.5699	5.7015	2.8778	6.5232	5.2113	2.7408	10.4	6.54655	5.4564	2.8093
311	6.1855	5.4187	3.1032	6.228	4.9111	2.9747	10.4	6.20675	5.1649	3.03895
312	6.0125	5.2625	3.1647	6.0721	4.7975	3.0234	10.4	6.0423	5.03	3.09405
312	5.9548	5.1663	3.2051	5.959	4.7268	3.0767	10.4	5.9569	4.94655	3.1409
312	5.8142	5.0767	3.1623	5.9292	4.6713	3.0424	10.4	5.8717	4.874	3.10235
312	5.8589	5.0319	3.1644	5.8419	4.6308	3.0488	10.4	5.8504	4.83135	3.1066
312	5.66	4.9692	2.8402	5.7409	4.5637	2.7503	10.4	5.70045	4.76645	2.79525
312	5.6742	4.8128	1.6411	5.7254	4.3389	1.5681	10.4	5.6998	4.57585	1.6046
312	5.3667	4.4535	1.1381	5.5031	3.9109	1.0865	10.4	5.4349	4.1822	1.1123
312	5.2011	4.1166	0.70002	5.2864	3.5351	0.62692	10.4	5.24375	3.82585	0.66347
312	4.9178	3.8156	2.0939	5.1141	3.3193	1.9952	10.4	5.01595	3.56745	2.04455
312	4.7982	4.0379	4.2003	4.9305	3.7215	4.0678	10.4	4.86435	3.8797	4.13405
312	5.1223	4.6571	6.3919	5.1095	4.5461	6.1833	10.4	5.1159	4.6016	6.2876
312	5.4404	5.4575	8.6449	5.4191	5.5214	8.4118	10.4	5.42975	5.48945	8.52835
312	6.0369	6.4072	10.18	5.8837	6.6412	9.8548	10.4	5.9603	6.5242	10.0174
312	6.7811	7.2824	9.7144	6.5047	7.5372	9.4396	10.4	6.6429	7.4098	9.577
312	7.1839	7.6679	8.7911	6.9588	7.8248	8.537	10.4	7.07135	7.74635	8.66405
312	7.5103	7.7225	7.6037	7.2131	7.7309	7.3829	10.4	7.3617	7.7267	7.4933
312	7.5381	7.5041	5.91	7.3088	7.4022	5.7226	10.4	7.42345	7.45315	5.8163
312	7.3426	7.0282	3.9983	7.1599	6.7307	3.8743	10.4	7.25125	6.87945	3.9363
312	6.8085	6.3789	2.9557	6.8893	5.9703	2.8744	10.4	6.8489	6.1746	2.91505
312	6.5505	5.7629	2.5067	6.542	5.2727	2.4382	10.4	6.54625	5.5178	2.47245
312	6.084	5.317	2.7227	6.233	4.8691	2.6456	10.4	6.1585	5.09305	2.68415
312	5.969	5.1123	2.7569	6.0286	4.6856	2.6798	10.4	5.9988	4.89895	2.71835
312	5.8056	4.9359	2.6911	5.861	4.5261	2.6182	10.4	5.8333	4.731	2.65465
312	5.7219	4.8221	2.624	5.7091	4.4251	2.5554	10.4	5.7155	4.6236	2.5897
313	5.5765	4.685	2.5119	5.6106	4.3006	2.4476	10.4	5.59355	4.4928	2.47975

313	5.3673	4.5565	2.4515	5.508	4.1891	2.3914	10.4	5.43765	4.3728	2.42145
313	5.3576	4.4657	2.2444	5.4173	4.0854	2.1972	10.4	5.38745	4.27555	2.2208
313	5.1778	4.3326	2.085	5.3228	3.9479	2.0507	10.4	5.2503	4.14025	2.06785
313	5.179	4.2184	1.919	5.2174	3.8337	1.8804	10.4	5.1982	4.02605	1.8997
313	5.0678	4.0941	1.7641	5.1317	3.7093	1.7298	10.4	5.09975	3.9017	1.74695
313	4.8169	3.9882	1.6019	4.9279	3.5691	1.5504	10.4	4.8724	3.77865	1.57615
313	4.8588	3.8421	1.2361	4.9229	3.4229	1.1975	10.4	4.89085	3.6325	1.2168
313	4.5876	3.7072	1.9508	4.7285	3.2879	1.9465	10.4	4.65805	3.49755	1.94865
313	4.5545	3.8152	3.8793	4.7125	3.6056	3.8408	10.4	4.6335	3.7104	3.86005
313	4.6974	4.3857	6.4703	4.7828	4.3857	6.3767	10.4	4.7401	4.3857	6.4235
313	5.2245	5.1307	7.2079	5.2373	5.2544	7.0634	10.4	5.2309	5.19255	7.13565
313	5.7372	5.8479	9.5869	5.5838	6.0949	9.2865	10.4	5.6605	5.9714	9.4367
313	6.1649	6.6158	10.441	6.016	6.9091	9.5202	10.4	6.09045	6.76245	9.9806
313	6.7421	7.532	11.889	6.4232	7.8332	11.009	10.4	6.58265	7.6826	11.449
313	7.3433	8.1237	9.1399	6.9824	8.1067	7.564	10.4	7.16285	8.1152	8.35195
313	7.5448	7.9434	6.1981	7.1798	7.4938	5.3424	10.4	7.3623	7.7186	5.77025
313	7.5037	7.2533	4.2383	7.1131	6.6414	3.6829	10.4	7.3084	6.94735	3.9606
313	6.9728	6.5307	3.4685	6.6923	5.8669	3.0706	10.4	6.83255	6.1988	3.26955
313	6.5721	5.8997	2.632	6.4232	5.2562	2.3191	10.4	6.49765	5.57795	2.47555
313	6.2895	5.3481	1.5703	6.1661	4.6698	1.3298	10.4	6.2278	5.00895	1.45005
313	5.8183	4.8078	1.4645	5.7246	4.1031	1.2454	10.4	5.77145	4.45545	1.35495
313	5.4653	4.4198	0.99213	5.4866	3.783	0.82019	10.4	5.47595	4.1014	0.90616
313	5.141	4.0179	0.46681	5.1496	3.3377	0.32482	10.4	5.1453	3.6778	0.395815
314	4.8358	3.7034	0.72658	4.8657	3.057	0.60184	10.5	4.85075	3.3802	0.66421
314	4.6262	3.5318	0.50671	4.7329	2.9495	0.41205	10.5	4.67955	3.24065	0.45938
314	4.4943	3.3055	-0.40984	4.5584	2.6716	-0.47449	10.5	4.52635	2.98855	-0.44217
314	4.1825	2.9459	-0.67283	4.3364	2.303	-0.73321	10.5	4.25945	2.62445	-0.70302
314	3.9915	2.6514	-1.1597	4.1197	2.008	-1.2115	10.5	4.0556	2.3297	-1.1856
314	3.7557	2.3164	-1.7695	3.9054	1.6512	-1.7997	10.5	3.83055	1.9838	-1.7846
314	3.4122	2.0407	-1.7923	3.5748	1.3193	-2.0171	10.5	3.4935	1.68	-1.9047
314	3.1471	1.8135	-1.8441	3.3013	0.98855	-2.0777	10.5	3.2242	1.401025	-1.9609
314	3.0135	1.6537	-0.9292	3.0649	0.88872	-1.0285	10.5	3.0392	1.27121	-0.97885
314	2.8301	1.689	1.0145	2.9158	1.2638	1.2337	10.5	2.87295	1.4764	1.1241
314	3.0067	2.2266	2.5911	3.1267	2.0464	2.6211	10.5	3.0667	2.1365	2.6061
314	3.3481	2.8856	5.2493	3.4636	2.9028	5.1001	10.5	3.40585	2.8942	5.1747
314	3.9109	3.9836	8.7579	3.804	4.2656	8.4189	10.5	3.85745	4.1246	8.5884
314	4.8278	5.2415	8.4508	4.6016	5.5612	8.0778	10.5	4.7147	5.40135	8.2643
314	5.4113	5.8799	7.6526	5.1812	6.0971	7.33	10.5	5.29625	5.9885	7.4913
314	5.7913	6.0766	6.2766	5.5783	6.1617	5.9957	10.5	5.6848	6.11915	6.13615
314	5.8628	5.9778	5.2449	5.6541	5.9011	4.989	10.5	5.75845	5.93945	5.11695
314	5.8835	5.7088	4.3823	5.8111	5.5682	4.173	10.5	5.8473	5.6385	4.27765
314	5.7381	5.4058	3.7195	5.6998	5.1926	3.557	10.5	5.71895	5.2992	3.63825
314	5.6165	5.1476	3.332	5.5185	4.866	3.1651	10.5	5.5675	5.0068	3.24855
314	5.4186	4.8513	2.8804	5.4314	4.5653	2.7476	10.5	5.425	4.7083	2.814
314	5.2996	4.6041	2.2123	5.257	4.2582	2.0836	10.5	5.2783	4.43115	2.14795
314	4.9682	4.2935	1.2646	4.998	3.8618	1.183	10.5	4.9831	4.07765	1.2238
314	4.7926	3.8527	0.21483	4.878	3.3693	0.15887	10.5	4.8353	3.611	0.18685
315	4.5092	3.342	-0.55376	4.5647	2.7938	-0.60118	10.5	4.53695	3.0679	-0.57747
315	4.091	2.8542	-1.1447	4.2663	2.2584	-1.1706	10.5	4.17865	2.5563	-1.15765
315	3.7298	2.4105	-1.7352	3.9051	1.8012	-1.7525	10.5	3.81745	2.10585	-1.74385
315	3.4687	2.1445	-1.8043	3.5629	1.4233	-1.9989	10.5	3.5158	1.7839	-1.9016
315	3.1291	1.7783	-2.1866	3.2704	0.99629	-2.3901	10.5	3.19975	1.387295	-2.28835
315	2.8401	1.4928	-2.5698	2.9472	0.62009	-2.7518	10.5	2.89365	1.056445	-2.6608
315	2.5962	1.2138	-2.908	2.6776	0.29315	-3.0988	10.5	2.6369	0.753475	-3.0034
315	2.3478	0.94313	-2.9602	2.4036	-0.0039	-3.086	10.5	2.3757	0.469615	-3.0231
315	2.0888	0.76959	-1.2433	2.1617	0.00764	-1.1526	10.5	2.12525	0.388615	-1.19795
315	1.9886	0.89746	1.4175	2.1217	0.68671	1.9629	10.5	2.05515	0.792085	1.6902
315	2.3964	1.7401	5.2487	2.5636	2.0877	5.5941	10.5	2.48	1.9139	5.4214
315	3.0145	3.1857	8.463	3.053	3.7889	8.6282	10.5	3.03375	3.4873	8.5456
315	4.1099	4.6778	10.611	3.9732	5.4625	10.463	10.5	4.04155	5.07015	10.537
315	4.9331	5.9556	11.553	4.8222	6.7723	11.178	10.5	4.87765	6.36395	11.3655
315	5.816	6.9768	11.055	5.5179	7.6602	10.528	10.5	5.66695	7.3185	10.7915
315	6.5306	7.4947	9.0369	6.1606	7.8128	7.2146	10.5	6.3456	7.65375	8.12575
315	6.8232	7.2521	5.6917	6.3938	6.9804	4.7499	10.5	6.6085	7.11625	5.2208
315	6.4507	6.5018	3.6535	6.1359	5.9997	2.9905	10.5	6.2933	6.25075	3.322
315	6.123	5.693	2.2786	5.842	5.0707	1.7769	10.5	5.9825	5.38185	2.02775
315	5.5432	4.9291	1.2472	5.3471	4.2502	0.86472	10.5	5.44515	4.58965	1.05596
315	5.1381	4.2331	0.36165	5.0357	3.5705	0.05612	10.5	5.0869	3.9018	0.208885
315	4.7599	3.6404	-0.32606	4.6959	2.9427	-0.58462	10.5	4.7279	3.29155	-0.45534
315	4.3332	3.1184	-0.96052	4.2478	2.3985	-1.1806	10.5	4.2905	2.75845	-1.07056

315	3.8781	2.5979	-1.511	3.955	1.8902	-1.4203	10.5	3.91655	2.24405	-1.46565
316	3.5204	2.2049	-1.4539	3.576	1.4665	-1.7824	10.5	3.5482	1.8357	-1.61815
316	3.2553	1.9564	-1.7345	3.3024	1.1575	-2.0631	10.5	3.27885	1.55695	-1.8988
316	3.0493	1.6854	-2.1286	3.0279	0.81737	-2.4662	10.5	3.0386	1.251385	-2.2974
316	2.7282	1.4108	-2.4012	2.7111	0.48628	-2.7131	10.5	2.71965	0.94854	-2.55715
316	2.5095	1.1485	-2.7222	2.5181	0.18904	-3.03	10.5	2.5138	0.66877	-2.8761
316	2.2781	0.91639	-3.091	2.188	-0.08233	-3.3774	10.5	2.23305	0.41703	-3.2342
316	2.0904	0.6463	-3.3507	2.0517	-0.37886	-3.6243	10.5	2.07105	0.13372	-3.4875
316	1.8278	0.37014	-3.4208	1.8106	-0.634	-3.5945	10.5	1.8192	-0.13193	-3.50765
316	1.4924	0.19762	-1.6664	1.501	-0.59973	-1.4806	10.5	1.4967	-0.20106	-1.5735
316	1.5561	0.43838	1.3156	1.5218	0.18874	1.7794	10.5	1.53895	0.31356	1.5475
316	1.85	1.2532	5.3146	1.9615	1.7127	5.6897	10.5	1.90575	1.48295	5.50215
316	2.6068	2.8124	8.8845	2.6411	3.5442	8.8972	10.5	2.62395	3.1783	8.89085
316	3.5635	4.4732	11.418	3.4651	5.3601	11.135	10.5	3.5143	4.91665	11.2765
316	4.8039	5.9709	12.574	4.5182	6.906	12.087	10.5	4.66105	6.43845	12.3305
316	5.6866	7.0849	12.317	5.3545	7.9161	11.577	10.5	5.52055	7.5005	11.947
316	6.5952	7.7961	10.553	6.1064	8.2452	8.5585	10.5	6.3508	8.02065	9.55575
316	6.8894	7.7168	7.0719	6.3966	7.5896	5.9969	10.5	6.643	7.6532	6.5344
316	6.7115	7.0768	4.89	6.2397	6.6563	4.1348	10.5	6.4756	6.86655	4.5124
316	6.4894	6.247	3.5049	6.0726	5.7491	2.9403	10.5	6.281	5.99805	3.2226
316	6.0116	5.5048	2.5569	5.6965	4.9549	2.1112	10.5	5.85405	5.22985	2.33405
316	5.6034	4.9127	2.1411	5.3775	4.345	1.7679	10.5	5.49045	4.62885	1.9545
316	5.2024	4.4342	1.9944	5.0446	3.9129	1.6897	10.5	5.1235	4.17355	1.84205
316	4.8448	4.1274	2.1667	4.7125	3.6486	1.8793	10.5	4.77865	3.888	2.023
316	4.6176	3.9726	2.0758	4.5536	3.5193	1.8055	10.5	4.5856	3.74595	1.94065
317	4.5221	3.8385	2.3314	4.4282	3.4364	2.0913	10.6	4.47515	3.63745	2.21135
317	4.4721	3.8013	2.3585	4.3354	3.4163	2.127	10.6	4.40375	3.6088	2.24275
317	4.4167	3.7671	2.3756	4.2714	3.3864	2.1741	10.6	4.34405	3.57675	2.27485
317	4.2973	3.7246	2.2687	4.2162	3.3439	2.0886	10.6	4.25675	3.53425	2.17865
317	4.2601	3.6617	2.2356	4.1618	3.3023	2.0383	10.6	4.21095	3.482	2.13695
317	4.1696	3.601	2.2864	4.1055	3.2545	2.1234	10.6	4.13755	3.42775	2.2049
317	4.1423	3.5951	2.2632	4.044	3.2485	2.1217	10.6	4.09315	3.4218	2.19245
317	4.0887	3.5671	2.1537	4.0118	3.2333	2.0378	10.6	4.05025	3.4002	2.09575
317	4.1566	3.5153	2.3633	4.0583	3.2072	2.2218	10.6	4.10745	3.36125	2.29255
317	4.1126	3.5568	3.0133	4.0314	3.3086	2.8719	10.6	4.072	3.4327	2.9426
317	4.1467	3.7363	4.0057	4.0655	3.5695	3.8304	10.6	4.1061	3.6529	3.91805
317	4.257	4.1459	5.5753	4.1289	4.0648	5.3111	10.6	4.19295	4.10535	5.4432
317	4.6818	4.6647	6.9095	4.5281	4.7287	6.5055	10.6	4.60495	4.6967	6.7075
317	4.9765	5.1641	7.1514	4.7418	5.2536	6.8412	10.6	4.85915	5.20885	6.9963
317	5.3559	5.5775	7.1683	5.0916	5.6882	6.8794	10.6	5.22375	5.63285	7.02385
317	5.592	5.8773	6.8216	5.3747	5.9624	6.4645	10.6	5.48335	5.91985	6.64305
317	5.7915	5.9746	5.8596	5.553	5.9831	5.5743	10.6	5.67225	5.97885	5.71695
317	5.8279	5.8151	4.0922	5.5383	5.6235	3.8529	10.6	5.6831	5.7193	3.97255
317	5.6126	5.3442	2.9478	5.4422	5.0457	2.7679	10.6	5.5274	5.19495	2.85785
317	5.3914	4.8029	1.8807	5.3019	4.4572	1.7477	10.6	5.34665	4.63005	1.8142
317	5.0211	4.3039	1.1465	4.9145	3.868	1.0434	10.6	4.9678	4.08595	1.09495
317	4.7006	3.812	0.53991	4.6536	3.3329	0.45818	10.6	4.6771	3.57245	0.499045
317	4.3367	3.3491	0.07857	4.4008	2.8696	0.00539	10.6	4.36875	3.10935	0.04198
317	4.0327	2.9844	-0.43507	4.0541	2.4703	-0.47817	10.6	4.0434	2.72735	-0.45662
317	3.6959	2.6168	-0.69768	3.7686	2.0937	-0.74512	10.6	3.73225	2.35525	-0.7214
318	3.4563	2.2996	-0.91343	3.5804	1.7976	-0.935	10.6	3.51835	2.0486	-0.92422
318	3.1936	2.0449	-1.1223	3.3006	1.534	-1.1352	10.6	3.2471	1.78945	-1.12875
318	3.0038	1.8289	-0.92094	3.1323	1.3436	-0.94252	10.6	3.06805	1.58625	-0.93173
318	2.9041	1.7375	-0.74549	2.9684	1.2822	-0.77569	10.6	2.93625	1.50985	-0.76059
318	2.7023	1.6383	-1.3718	2.8266	1.1915	-1.3761	10.6	2.76445	1.4149	-1.37395
318	2.6293	1.4578	-1.5103	2.7194	0.98076	-1.277	10.6	2.67435	1.21928	-1.39365
318	2.5032	1.383	-1.5424	2.5461	0.79403	-1.7542	10.6	2.52465	1.088515	-1.6483
318	2.3293	1.2045	-0.78467	2.3465	0.6541	-0.62077	10.6	2.3379	0.9293	-0.70272
318	2.2336	1.2764	2.958	2.298	1.2292	3.339	10.6	2.2658	1.2528	3.1485
318	2.553	2.343	7.1104	2.6173	2.7029	7.1401	10.6	2.58515	2.52295	7.12525
318	3.3727	3.8003	9.408	3.3471	4.3769	9.2727	10.6	3.3599	4.0886	9.34035
318	4.2896	5.2662	13.099	4.0633	6.0752	12.792	10.6	4.17645	5.6707	12.9455
318	5.514	6.9637	14.835	5.1094	7.9139	14.421	10.6	5.3117	7.4388	14.628
318	6.5472	8.3328	13.246	6.0967	9.1874	12.743	10.6	6.32195	8.7601	12.9945
318	7.2796	8.7963	12.283	6.7618	9.384	11.269	10.6	7.0207	9.09015	11.776
318	7.7189	8.82	9.9399	7.1929	9.1245	9.3486	10.6	7.4559	8.97225	9.64425
318	7.6668	8.4209	8.4717	7.2511	8.5395	8.0398	10.6	7.45895	8.4802	8.25575
318	7.6733	8.0167	7.3764	7.2703	8.0251	7.0453	10.6	7.4718	8.0209	7.21085
318	7.4147	7.5463	6.6377	7.1006	7.5081	6.3614	10.6	7.25765	7.5272	6.49955
318	7.1928	7.1758	6.8361	6.9211	7.1164	6.5727	10.6	7.05695	7.1461	6.7044
318	7.0327	7.0327	7.1176	6.8076	6.986	6.8331	10.6	6.92015	7.00935	6.97535
318	6.8258	6.9618	7.0255	6.6261	6.9151	6.7791	10.6	6.72595	6.93845	6.9023

11.E. Thermocouple Data from Selected Dates Corresponding to Strain Data

Data Type	Year	Day	Hour	Ref Temp							
123	2008	25	1700	12.641							
					Thermalcouple String 1						
1	2	3	4	5	6	7	8	9	10	11	12
33405	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999
					Thermocouple String 2						
1		3	4	5	6	7	8	9	10	11	12
-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999
					Asphalt						
Shed Temp	Second Multiplexure	Ref Temp	1	2	3	4	5	6	Outside Temp		
-99999	-99999	9.7528	-4.671	-4.4361	-5.0801	-5.2979	-4.7885	-5.6422	-5.9389		
Data Type	Year	Day	Hour	Ref Temp							
123	2008	26	1600	12.361							
					Thermalcouple String 1						
1	2	3	4	5	6	7	8	9	10	11	12
33405	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999
					Thermocouple String 2						
1		3	4	5	6	7	8	9	10	11	12
-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999
					Asphalt						
Shed Temp	Second Multiplexure	Ref Temp	1	2	3	4	5	6	Outside Temp		
-99999	-99999	20.549	-2.6579	-1.6554	-1.1249	-2.8439	-1.4656	-1.7418	-3.6192		
Data Type	Year	Day	Hour	Ref Temp							
123	2008	29	1800	12.453							
					Thermalcouple String 1						
1	2	3	4	5	6	7	8	9	10	11	12
33405	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999
					Thermocouple String 2						
1		3	4	5	6	7	8	9	10	11	12
-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999	-99999
					Asphalt						
Shed Temp	Second Multiplexure	Ref Temp	1	2	3	4	5	6	Outside Temp		
-99999	-99999	20.09	-0.74994	-0.05699	0.92279	-1.0472	0.54484	0.51477	-2.1563		

11.F. MEPDG Analysis

(1) Input Summary

Project: MQP_07_08

General Information

Design Life	20 years	Description:
Base/Subgrade construction:	N/A	
Pavement construction:	N/A	
Traffic open:	N/A	
Type of design	Flexible	

Analysis Parameters

Performance Criteria

	Limit	Reliability
Initial IRI (in/mi)	63	
Terminal IRI (in/mi)	172	90
AC Surface Down Cracking (Long. Cracking) (ft/mile):	2000	90
AC Bottom Up Cracking (Alligator Cracking) (%):	25	90
AC Thermal Fracture (Transverse Cracking) (ft/mi):	1000	90
Chemically Stabilized Layer (Fatigue Fracture)	25	90
Permanent Deformation (AC Only) (in):	0.25	90
Permanent Deformation (Total Pavement) (in):	0.75	90
Reflective cracking (%):	100	

Location:	Guilford, Maine	
Project ID:		10567
Section ID:		
Date:		
Station/milepost format:		
Station/milepost begin:		
Station/milepost end:		
Traffic direction:	East bound	

Default Input Level

Default input level — Level 3, Default and historical agency values.

Traffic

Initial two-way AADTT:	345
Number of lanes in design direction:	1
Percent of trucks in design direction (%):	50
Percent of trucks in design lane (%):	100
Operational speed (mph):	65

Traffic -- Volume Adjustment Factors

Monthly Adjustment Factors (Level 3, Default MAF)

	Vehicle Class									
Month	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13
January	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
February	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
March	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
April	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
May	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
June	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
July	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
August	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
September	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
October	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
November	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
December	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Vehicle Class Distribution

(Level 1, Site Specific Distribution)

AADTT distribution by vehicle class

Class 4	6.2%
Class 5	23.3%
Class 6	8.7%
Class 7	1.0%
Class 8	2.7%
Class 9	8.9%
Class 10	49.2%
Class 11	0.0%
Class 12	0.0%
Class 13	0.0%

Hourly truck traffic distribution

by period beginning:

Midnight	2.3%	Noon	5.9%
1:00 am	2.3%	1:00 pm	5.9%
2:00 am	2.3%	2:00 pm	5.9%
3:00 am	2.3%	3:00 pm	5.9%
4:00 am	2.3%	4:00 pm	4.6%
5:00 am	2.3%	5:00 pm	4.6%
6:00 am	5.0%	6:00 pm	4.6%
7:00 am	5.0%	7:00 pm	4.6%
8:00 am	5.0%	8:00 pm	3.1%
9:00 am	5.0%	9:00 pm	3.1%
10:00 am	5.9%	10:00 pm	3.1%
11:00 am	5.9%	11:00 pm	3.1%

Traffic Growth Factor

Vehicle Class	Growth Rate	Growth Function
Class 4	4.0%	Linear
Class 5	4.0%	Linear
Class 6	4.0%	Linear
Class 7	4.0%	Linear
Class 8	4.0%	Linear
Class 9	4.0%	Linear
Class 10	4.0%	Linear
Class 11	4.0%	Linear
Class 12	4.0%	Linear
Class 13	4.0%	Linear

Traffic -- Axle Load Distribution Factors

Level 3: Default

Traffic -- General Traffic Inputs

Mean wheel location (inches from the lane marking):	18
Traffic wander standard deviation (in):	10
Design lane width (ft):	12

Number of Axles per Truck

Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.62	0.39	0.00	0.00
Class 5	2.00	0.00	0.00	0.00
Class 6	1.02	0.99	0.00	0.00
Class 7	1.00	0.26	0.83	0.00
Class 8	2.38	0.67	0.00	0.00
Class 9	1.13	1.93	0.00	0.00
Class 10	1.19	1.09	0.89	0.00
Class 11	4.29	0.26	0.06	0.00
Class 12	3.52	1.14	0.06	0.00
Class 13	2.15	2.13	0.35	0.00

Axle Configuration

Average axle width (edge-to-edge) outside dimensions,ft):	8.5
Dual tire spacing (in):	13

Axle Configuration

Tire Pressure (psi) :	120

Average Axle Spacing

Tandem axle(psi): 48
Tridem axle(psi): 48
Quad axle(psi): 48

Climate

icm file: C:\Documents and Settings\Squee!!!\My Documents\School\MQP\MEPDG\MEPDG\Projects\MQP_07_08\Climate.icm
Latitude (degrees.minutes) 45.36
Longitude (degrees.minutes) -68.67
Elevation (ft) 250
Depth of water table (ft) 3

Structure--Design Features

HMA E* Predictive Model: NCHRP 1-37A viscosity based model.
HMA Rutting Model coefficients: NCHRP 1-37A coefficients
Endurance Limit (microstrain): None (0 microstrain)

Structure--Layers

Layer 1 -- Asphalt concrete

Material type: Asphalt concrete
Layer thickness (in): 3

General Properties

General
Reference temperature (F°): 70

Volumetric Properties as Built
Effective binder content (%): 5.5
Air voids (%): 5.1
Total unit weight (pcf): 148

Poisson's ratio: 0.35 (user entered)

Thermal Properties
Thermal conductivity asphalt (BTU/hr-ft-F°): 0.67
Heat capacity asphalt (BTU/lb-F°): 0.23

Asphalt Mix

Cumulative % Retained 3/4 inch sieve: 10
Cumulative % Retained 3/8 inch sieve: 20
Cumulative % Retained #4 sieve: 30
% Passing #200 sieve: 6

Asphalt Binder

Option: Superpave binder grading
A 10.3120 (correlated)
VTS: -3.4400 (correlated)

High temp. °C	Low temperature, °C						
	-10	-16	-22	-28	-34	-40	-46
46							
52							
58							
64							
70							
76							
82							

Thermal Cracking Properties

Average Tensile Strength at 14ºF:	845.29
Mixture VMA (%)	10.6
Aggreagate coeff. thermal contraction (in./in.)	0.000005
Mix coeff. thermal contraction (in./in./ºF):	0.000013

Load Time (sec)	Low Temp. -4ºF (1/psi)	Mid. Temp. 14ºF (1/psi)	High Temp. 32ºF (1/psi)
1	1.01E-07	1.88E-07	2.81E-07
2	1.11E-07	2.19E-07	3.63E-07
5	1.25E-07	2.7E-07	5.1E-07
10	1.38E-07	3.16E-07	6.58E-07
20	1.51E-07	3.69E-07	8.51E-07
50	1.72E-07	4.55E-07	1.19E-06
100	1.88E-07	5.32E-07	1.54E-06

Layer 2 -- Crushed gravel

Unbound Material:	Crushed gravel
Thickness(in):	6

Strength Properties

Input Level:	Level 3
Analysis Type:	ICM inputs (ICM Calculated Modulus)
Poisson's ratio:	0.4
Coefficient of lateral pressure,Ko:	0.5
Modulus (input) (psi):	21756

ICM Inputs

Gradation and Plasticity Index

Plasticity Index, PI:	1
Liquid Limit (LL)	6
Compacted Layer	No
Passing #200 sieve (%):	0
Passing #40	14
Passing #4 sieve (%):	52
D10(mm)	0.2645
D20(mm)	0.781
D30(mm)	1.327
D60(mm)	9.5
D90(mm)	16.14

Sieve	Percent Passing
0.001mm	
0.002mm	
0.020mm	
#200	0
#100	
#80	
#60	
#50	11
#40	14
#30	17
#20	22
#16	28
#10	37
#8	40
#4	52
3/8"	60
1/2"	69
3/4"	76
1"	81
1 1/2"	
2"	
2 1/2"	
3"	
3 1/2"	
4"	

Calculated/Derived Parameters

Maximum dry unit weight (pcf): 115.3 (derived)
Specific gravity of solids, Gs: 2.70 (derived)
Saturated hydraulic conductivity (ft/hr): 0.5888 (derived)
Optimum gravimetric water content (%): 7.1 (derived)
Calculated degree of saturation (%): 41.4 (calculated)

Soil water characteristic curve parameters: Default values

Parameters	Value
a	5
b	4
c	0.88924
Hr.	100

Layer 3 -- A-5

Unbound Material: A-5
Thickness(in): Semi-infinite

Strength Properties

Input Level: Level 3
Analysis Type: ICM inputs (ICM Calculated Modulus)
Poisson's ratio: 0.35
Coefficient of lateral pressure,Ko: 0.5
Modulus (input) (psi): 15500

ICM Inputs

Gradation and Plasticity Index

Plasticity Index, PI: 5
Liquid Limit (LL) 45
Compacted Layer No
Passing #200 sieve (%): 54.3
Passing #40 74.3
Passing #4 sieve (%): 86.9
D10(mm) 0.0003384
D20(mm) 0.001145
D30(mm) 0.003876
D60(mm) 0.1234
D90(mm) 9.109

Sieve	Percent Passing
0.001mm	
0.002mm	
0.020mm	
#200	54.3
#100	
#80	66.2
#60	
#50	
#40	74.3
#30	
#20	
#16	
#10	82.6
#8	
#4	86.9
3/8"	90.2
1/2"	91.9
3/4"	94.1
1"	95.9
1 1/2"	97.5
2"	98.5
2 1/2"	
3"	
3 1/2"	99.5
4"	99.5

Calculated/Derived Parameters

Maximum dry unit weight (pcf): 119.2 (derived)
Specific gravity of solids, Gs: 2.70 (derived)
Saturated hydraulic conductivity (ft/hr): 9.256e-007 (derived)
Optimum gravimetric water content (%): 11.4 (derived)
Calculated degree of saturation (%): 74.4 (calculated)

Soil water characteristic curve parameters: Default values

Parameters	Value
a	65.233
b	1.0338
c	0.49936
Hr.	500

Distress Model Calibration Settings - Flexible

AC Fatigue Level 3: NCHRP 1-37A coefficients (nationally calibrated values)

k1 0.007566
k2 3.9492
k3 1.281

AC Rutting Level 3: NCHRP 1-37A coefficients (nationally calibrated values)

k1 -3.35412
k2 1.5606
k3 0.4791

Standard Deviation Total Rutting (RUT): 0.24*POWER(RUT,0.8026)+0.001

Thermal Fracture Level 3: NCHRP 1-37A coefficients (nationally calibrated values)

k1 1.5

Std. Dev. (THERMAL): 0.1468 * THERMAL + 65.027

CSM Fatigue	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
k1	1
k2	1
Subgrade Rutting	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
Granular:	
k1	2.03
Fine-grain:	
k1	1.35
AC Cracking	
AC Top Down Cracking	
C1 (top)	7
C2 (top)	3.5
C3 (top)	0
C4 (top)	1000
Standard Deviation (TOP)	200 + 2300/(1+exp(1.072-2.1654*log(TOP+0.0001)))
AC Bottom Up Cracking	
C1 (bottom)	1
C2 (bottom)	1
C3 (bottom)	0
C4 (bottom)	6000
Standard Deviation (TOP)	1.13+13/(1+exp(7.57-15.5*log(BOTTOM+0.0001)))
CSM Cracking	
C1 (CSM)	1
C2 (CSM)	1
C3 (CSM)	0
C4 (CSM)	1000
Standard Deviation (CSM)	CTB*1
IRI	
IRI HMA Pavements New	
C1(HMA)	40
C2(HMA)	0.4
C3(HMA)	0.008
C4(HMA)	0.015
IRI HMA/PCC Pavements	
C1(HMA/PCC)	40.8
C2(HMA/PCC)	0.575
C3(HMA/PCC)	0.0014
C4(HMA/PCC)	0.00825

(2) Climate Summary

Climate Summary

Climate Station File:

C:\Documents and Settings\Squee!!!\My Documents\School\MQP\MEPDG\MEPDG\Projects\MQP_07_08\Climate.icm

Climate station(s) used in analysis:

15.7 miles MILLINOCKET, ME - MILLINOCKET MUNICIPAL ARPT Lat. 45.39 Lon. -68.41 Ele. 408 Months: 116 (C)
54.8 miles BANGOR, ME - BANGOR INTERNATIONAL ARPT Lat. 44.49 Lon. -68.49 Ele. 197 Months: 95 (C)
68.5 miles HOULTON, ME - INTERNATIONAL AIRPORT Lat. 46.07 Lon. -67.47 Ele. 496 Months: 66 (M1)

Average Monthly Quintile Temperatures - Surface

Month	1st Quintile (ºF)	2nd Quintile (ºF)	3rd Quintile (ºF)	4th Quintile (ºF)	5th Quintile (ºF)	Mean Temp. (ºF)	Std. Dev. (ºF)
January	4.2	13.4	19.2	24.8	32.4	18.8	10.1
February	8.5	18.4	25.1	31.2	40.4	24.8	11.5
March	16.4	26.7	32.6	39.3	51.1	33.2	12.4
April	31.8	39.4	46	54.7	70.5	48.5	14
May	45	53.5	60.6	70.8	88.8	63.8	15.8
June	54.6	64.8	73.3	85.5	102.2	76.1	17.1
July	60.4	68.9	77.5	89.5	104.5	80.2	16
August	58.2	67.2	75.2	86.7	101.9	77.9	15.8
September	49	57.8	64.6	73	89.1	66.7	14.4
October	35.5	43.2	48.8	55.3	68.6	50.3	11.9
November	25.1	32.3	37	42	50.8	37.4	9.2
December	13.8	22	27.4	32.2	39.2	26.9	9.1

Average Monthly Quintile Temperatures - Sublayer 1

Month	1st Quintile (ºF)	2nd Quintile (ºF)	3rd Quintile (ºF)	4th Quintile (ºF)	5th Quintile (ºF)	Mean Temp. (ºF)	Std. Dev. (ºF)
January	4.9	13.8	19.4	24.7	31.9	19	9.7
February	9.1	18.8	25.1	30.9	39.5	24.7	10.9
March	16.9	26.8	32.5	38.9	49.9	33	11.8
April	32.4	39.8	46.1	54.3	69.3	48.4	13.4
May	45.6	53.9	60.8	70.4	87.5	63.7	15.1
June	55.3	65.3	73.4	84.9	100.9	76	16.4
July	61.2	69.5	77.6	88.9	103.2	80.1	15.2
August	59	67.8	75.4	86.1	100.6	77.8	15
September	49.7	58.3	64.8	72.7	88	66.7	13.7
October	36.1	43.6	49	55.1	67.8	50.3	11.4
November	25.5	32.5	37.1	41.9	50.3	37.5	8.9
December	14.4	22.3	27.6	32.1	38.7	27	8.8

Average Monthly Quintile Temperatures - Sublayer 2

Month	1st Quintile (ºF)	2nd Quintile (ºF)	3rd Quintile (ºF)	4th Quintile (ºF)	5th Quintile (ºF)	Mean Temp. (ºF)	Std. Dev. (ºF)
January	6.2	14.6	19.8	24.6	31	19.3	8.9
February	10.4	19.4	25.2	30.4	37.7	24.7	9.8
March	18	27.2	32.3	38	47.6	32.6	10.6
April	33.4	40.4	46.3	53.5	67	48.1	12.2
May	46.8	54.6	61	69.6	85.2	63.5	13.8
June	56.6	66.1	73.7	83.9	98.5	75.7	15
July	62.7	70.5	77.8	87.8	100.9	79.9	13.8
August	60.6	68.8	75.8	85.1	98.4	77.7	13.6
September	51	59.1	65.2	72.3	86	66.7	12.5
October	37.2	44.3	49.4	55	66.4	50.5	10.5
November	26.5	32.9	37.3	41.7	49.5	37.6	8.2
December	15.6	23	27.8	31.9	37.8	27.2	8

Average Monthly Quintile Temperatures - Sublayer 3

Month	1st Quintile (ºF)	2nd Quintile (ºF)	3rd Quintile (ºF)	4th Quintile (ºF)	5th Quintile (ºF)	Mean Temp. (ºF)	Std. Dev. (ºF)
January	8	15.6	20.3	24.6	29.8	19.7	7.9
February	12.1	20.3	25.3	29.7	35.4	24.6	8.4
March	19.5	27.5	31.9	36.6	44.7	32.1	9.1
April	34.6	41	46.2	52.5	64.2	47.7	10.7
May	48.2	55.4	61.2	68.7	82.3	63.2	12.2
June	58.1	67	73.9	82.6	95.4	75.4	13.3
July	64.6	71.7	78	86.4	97.8	79.7	12
August	62.5	70.1	76.2	83.9	95.4	77.6	11.8
September	52.6	60.1	65.7	71.8	83.5	66.7	11
October	38.6	45.2	49.8	54.9	64.7	50.6	9.4
November	27.8	33.4	37.5	41.6	48.5	37.8	7.4
December	17.3	23.8	28	31.6	36.7	27.5	7

Average Monthly Quintile Temperatures - Sublayer 4

Month	1st Quintile (ºF)	2nd Quintile (ºF)	3rd Quintile (ºF)	4th Quintile (ºF)	5th Quintile (ºF)	Mean Temp. (ºF)	Std. Dev. (ºF)
January	10.2	16.8	21	24.6	28.7	20.3	6.7
February	14.1	21.2	25.4	28.8	32.9	24.5	6.9
March	21.2	27.7	31	34.7	41.9	31.3	7.5
April	35.8	41.4	46	51.4	61.4	47.2	9.3
May	49.5	56.1	61.3	67.7	79.3	62.8	10.7
June	59.6	67.7	73.9	81.2	92.3	75	11.7
July	66.4	72.7	78.2	85	94.8	79.4	10.2
August	64.5	71.2	76.4	82.7	92.5	77.5	10
September	54.3	61.1	66.1	71.3	81.1	66.8	9.6
October	40	46.1	50.3	54.7	63.2	50.9	8.3
November	29.1	33.9	37.7	41.6	47.6	38	6.7
December	19.3	24.8	28.4	31.2	35.5	27.9	5.9

Annual Climate Statistics

Mean annual air temperature (ºF):	42.78
Mean annual rainfall (in):	35.3
Freezing index (ºF-days):	1531.91
Average Annual Number of Freeze/Thaw Cycles:	87

Monthly Rainfall Statistics

Month	Mean Rainfall (in)	Std. Dev. (in)
January	1.85	1.21
February	2.65	1.67
March	2.71	2.45
April	2.88	1.49
May	2.86	0.89
June	3.64	0.85
July	3.35	1.95
August	3.85	1.9
September	3.01	2.06
October	2.88	1.24
November	3.24	1.41

Monthly Climate Summary

Month(Year)	Min. Temp. (ºF)	Max. Temp. (ºF)	Average Temp. (ºF)	Max. Range (ºF)	Precip. (in.)	Average Wind (mph)	Average Sun (%)	Number Wet Days	Max. Frost (in.)
9/1996	37.3	84.3	56	34	4.37	4.5	51.5	13	0
10/1996	24.4	68.5	43.2	27	1.38	5.7	52.2	6	3
11/1996	1.3	64.3	31.9	31	0.76	5.4	43.8	3	21
12/1996	-6.6	50.5	27.5	39.9	4.61	5.3	31.3	16	27.8
1/1997	-17.6	42.4	16.2	44	2.34	6.4	45.2	3	53.6
2/1997	-17.6	45.4	18.2	47	0	4.7	42.5	0	62.8
3/1997	-7.7	49.4	23.4	34	0	6.7	48.2	0	72.4
4/1997	18.4	60.4	37.7	32.9	0	6.7	44.8	0	70.3
5/1997	28.3	74.4	48.2	39.9	1.37	6	36.4	7	0.9
6/1997	36.4	88.5	63.2	39.9	1.44	4.6	70.7	9	0
7/1997	45.4	90.4	68	34.9	2.71	5	69.2	7	0
8/1997	44.4	88.4	64.1	31	3.18	3.5	57.2	14	0
9/1997	33.4	76.4	56.4	27	2.97	4.2	45.1	13	0
10/1997	20.4	72.4	43.5	32.1	0.75	4.7	49.1	10	5.2
11/1997	8.4	61.5	32	22	3.22	5.5	42.3	15	17.9
12/1997	-5.6	42.4	21.4	35	2.64	5.2	41.4	12	32.9
1/1998	-16.6	46.4	19.1	31	4.62	5.7	30.6	16	47.8
2/1998	-3.5	48.3	24.7	38.9	3.36	5.2	52.3	6	54.8
3/1998	0.4	69.4	29.8	35.1	4.01	5.7	32.8	15	55.1
4/1998	23.6	73	43	37.2	2.4	6.3	57.3	9	1.6
5/1998	35.4	84.2	58.1	40.8	3.87	5.3	52.7	12	0
6/1998	37.5	81.5	61.3	36.6	4.65	5.4	32.6	21	0
7/1998	49.4	88.6	67.8	29.8	3.31	4.1	65.7	13	0
8/1998	45.5	89.4	66.9	31.7	2.4	3.8	66.4	9	0
9/1998	37.5	79	58.3	32.6	2.22	4.5	44.8	12	0
10/1998	21.5	68.3	46.7	30.8	3.77	6.8	37.7	11	1.8
11/1998	15	48.4	34.6	19	2.54	6.2	32	10	8.7
12/1998	-12.1	56.1	26.5	37.9	1.15	6	48.5	12	28.8
1/1999	-22.1	46.8	14.6	46.6	6.21	5.6	50.9	14	54.8
2/1999	-5.2	43.4	23.2	32.8	2	6.3	59.9	8	61.9
3/1999	6.2	62.5	31.9	38.6	5.23	7.9	40.5	17	61.9
4/1999	23.7	67.3	41.9	28.8	0.84	7.2	42.7	5	2.6
5/1999	29.9	87.2	57.6	43.4	2.66	5	61.6	11	0
6/1999	42.5	89.5	66	33.2	3.02	4.5	64.6	17	0
7/1999	51.3	92.7	69.2	30.6	3.83	4.4	66.3	15	0
8/1999	42.6	86.3	65.2	30.7	3.2	4	63.5	16	0
9/1999	36.6	91.4	62.5	39.3	7.85	4.7	53.7	12	0
10/1999	19.7	63.2	43.2	27.5	3.71	5.8	50.3	13	5.2
11/1999	14.8	62.3	38.1	29	3.63	6.3	36.6	10	7.1
12/1999	0.2	50.9	25.9	27.4	2.92	6.1	49.5	11	29.5
1/2000	-15.9	47.9	14.9	30.8	3.22	7.3	47.8	14	50.2
2/2000	-11.9	51.5	19.2	39.6	2.95	6.1	48.4	9	64.4
3/2000	0.8	57.5	33.2	37.4	3.46	5.2	51.5	13	64.8
4/2000	20.9	71.5	39.9	37.9	5.37	6.2	34.6	14	5.4
5/2000	28.3	74.6	51.4	34	4.34	5.4	44.6	12	0.5
6/2000	33.9	85.2	61.1	30.4	2.05	4.4	58.6	13	0
7/2000	45.5	82.5	64.4	27.3	3.91	4.3	50.6	19	0
8/2000	43.8	83.5	64.2	30.9	2.94	3.8	53.3	15	0
9/2000	26.3	86	55.5	30.8	1.57	4.7	60.2	17	0.8
10/2000	21.7	71.7	44.7	36.3	2.84	5.3	52.3	10	2.2
11/2000	6.4	57.4	36.2	27.1	2.36	5.5	18	14	16.7
12/2000	-2.5	56.6	18.5	33	4.06	7.3	46.9	9	38.4
1/2001	-7	33.2	15.1	35	0.83	4.3	53.3	11	53.6
2/2001	-6.1	43.4	16.9	38.7	1.96	6.7	48.2	11	66.4
3/2001	-22	50.1	25.5	39.6	1.91	6.7	52.9	10	73.2
4/2001	17.5	72.1	38.5	39	0.52	6	60.6	8	73.5
5/2001	30.5	85.9	56.3	42.2	1.09	5.1	62.6	14	0
6/2001	44.7	92.5	65.7	34	2.84	4.6	57.6	14	0
7/2001	47.1	88.5	65.7	33.2	3.64	4.2	55	16	0
8/2001	39.2	93.4	69.1	33.2	1.56	3.8	72.9	10	0
9/2001	29.6	88.4	58.9	33.6	3.99	4.1	64	10	0
10/2001	25	78.4	47.8	36.5	1.58	4.4	55.5	16	2.6
11/2001	19.7	62.6	37.7	27.1	1.92	5.6	34.4	16	6.4
12/2001	5.8	54.7	29.3	23.8	1.86	4.8	48.1	13	23.7

1/2002	-2	37.3	21	25.2	1.95	4.6	32.9	18	38.4
2/2002	-10.5	46.4	21.4	40.2	3.5	5.9	43.1	12	50.7
3/2002	5.4	58.4	28.1	36.5	3.55	5.9	50.8	17	48.4
4/2002	18.7	66.5	40.2	29.7	4.55	5.9	36.9	15	6.3
5/2002	30.4	77.9	51	39.9	3.41	6.3	54.3	16	0
6/2002	31.7	86.3	60.1	35.5	3.16	4.6	57.2	16	0
7/2002	43.5	93.4	66.8	31.9	3.58	4.4	59	20	0
8/2002	41.1	93.3	68.1	31.5	0.75	3.8	78.4	12	0
9/2002	33.8	94.4	60.3	35.5	5.01	4.1	61.9	18	0
10/2002	17.7	78.4	42.1	29.9	2.92	5	51.2	15	5.7
11/2002	5.3	63.4	31.3	23.9	2.24	5.6	35.1	15	18.1
12/2002	-6.2	42.1	22.5	35.7	2.21	6.2	52.1	8	28.5
1/2003	-11.3	31.5	9	30	0.09	6.1	54.3	5	59
2/2003	-18.1	40.6	12.5	41.6	0.53	6.7	57.3	7	69.5
3/2003	-14.6	49.5	25.3	39.8	0.79	5.4	45.8	8	76.6
4/2003	12.6	72.4	36.8	40.2	0.47	4.8	56.4	7	78
5/2003	28.6	86.4	51.7	43.1	0.71	4.3	39.3	13	0.1
6/2003	34.8	93.2	63.1	36.2	3.22	4.2	65.5	13	0
7/2003	46.4	83.3	67.1	27.2	2.44	3.9	61.6	18	0
8/2003	44.1	85.4	66.9	32.8	3.05	4.3	53	15	0
9/2003	34.7	82.3	59.5	37.7	4.7	3.3	56.8	13	0
10/2003	25	76.5	45.3	36.7	7.95	4.9	40.5	15	3.2
11/2003	16.6	68.5	34.9	28.7	4.84	5.5	44	12	8.9
12/2003	-9.1	51.7	23.8	40.9	5.68	6.6	43.7	13	25.4
1/2004	-20	36.3	6.2	36.4	0.64	8.3	57.8	6	57.6
2/2004	-17.4	42.1	19.2	33.7	0.88	6.2	63.8	7	67.8
3/2004	3.8	49.2	29.3	32.5	1.31	5.3	49.7	11	73.5
4/2004	20.6	82.5	40.5	39.2	3.13	6.6	49.6	12	74.2
5/2004	30	84.1	52.3	37.6	3.28	5.5	48.8	19	0.3
6/2004	36.3	87.5	59.2	36.5	2.17	5.1	58.9	13	0
7/2004	44.7	85.2	65.4	30.1	5.54	3.3	53.3	17	0
8/2004	42.5	86.6	65.6	29.1	7.21	3.8	60.5	18	0
9/2004	6.9	77.2	57.2	68.4	1.94	4.3	67.9	7	0
10/2004	23.3	72.3	46.3	32.9	2.21	4.8	53.4	10	2.1
11/2004	15.4	55.5	33.6	26.1	4.38	5.7	52.2	9	7.9
12/2004	-6.7	52.8	19.7	37.8	4.01	5.7	40.8	13	33.6
1/2005	-16.2	50.9	11.9	35.8	1.73	6	59.5	12	57.9
2/2005	-10.9	46.1	20	38.6	1.45	4.9	61.6	8	67.1
3/2005	-13.2	50.7	26.7	39.8	3.58	6.3	52.8	9	73.7
4/2005	21.5	69.4	41.9	42.9	7.15	6.2	46.9	16	74.2
5/2005	29.1	72.9	48.5	33.6	5.16	5.7	30.2	17	0
6/2005	41.1	93.6	64.8	37.3	3.19	4.6	59.6	16	0
7/2005	47.5	87.5	67.8	31.2	3.76	3.9	68	14	0

Hourly Air Temperature Distribution by Month

Month/Year	Less than -13ºF	From -13ºF to -4ºF	From -4ºF to 5ºF	From 5ºF to 14ºF	From 14ºF to 23ºF	From 23ºF to 32ºF	From 32ºF to 41ºF	From 41ºF to 50ºF	From 50ºF to 59ºF	From 59ºF to 68ºF	From 68ºF to 77ºF	From 77ºF to 86ºF	From 86ºF to 95ºF	From 95ºF to 104ºF	From 104ºF to 113ºF	Greater than 113ºF
9/1996	0	0	1	0	0	0	35	195	322	122	34	11	0	0	0	0
10/1996	0	0	0	0	0	95	248	319	69	13	0	0	0	0	0	0
11/1996	0	0	10	19	92	327	175	57	27	13	0	0	0	0	0	0
12/1996	0	12	20	15	132	403	140	22	0	0	0	0	0	0	0	0
1/1997	5	32	57	201	262	151	36	0	0	0	0	0	0	0	0	0
2/1997	8	20	78	111	180	234	37	4	0	0	0	0	0	0	0	0
3/1997	0	5	32	111	189	297	95	15	0	0	0	0	0	0	0	0
4/1997	0	0	0	0	27	255	239	143	56	0	0	0	0	0	0	0
5/1997	0	0	0	0	0	11	178	352	143	41	19	0	0	0	0	0
6/1997	0	0	0	0	0	0	19	81	198	236	135	45	6	0	0	0
7/1997	0	0	0	0	0	0	0	22	127	292	208	91	4	0	0	0
8/1997	0	0	0	0	0	0	0	40	244	276	146	35	3	0	0	0
9/1997	0	0	0	0	0	1	43	166	292	179	39	0	0	0	0	0
10/1997	0	0	0	0	7	125	210	255	121	20	6	0	0	0	0	0
11/1997	0	0	0	10	90	361	130	94	34	1	0	0	0	0	0	0
12/1997	0	4	53	119	169	366	33	0	0	0	0	0	0	0	0	0
1/1998	6	17	52	128	235	283	17	6	0	0	0	0	0	0	0	0
2/1998	0	0	56	93	96	247	168	12	0	0	0	0	0	0	0	0
3/1998	0	0	12	73	94	323	146	60	25	11	0	0	0	0	0	0
4/1998	0	0	0	0	0	136	267	183	100	29	5	0	0	0	0	0
5/1998	0	0	0	0	0	0	24	181	281	165	78	15	0	0	0	0
6/1998	0	0	0	0	0	0	9	97	213	285	104	12	0	0	0	0

7/1998	0	0	0	0	0	0	0	11	149	294	208	79	3	0	0	0
8/1998	0	0	0	0	0	0	0	33	150	287	201	69	4	0	0	0
9/1998	0	0	0	0	0	0	11	126	322	212	48	1	0	0	0	0
10/1998	0	0	0	0	2	33	152	412	124	21	0	0	0	0	0	0
11/1998	0	0	0	0	30	276	354	60	0	0	0	0	0	0	0	0
12/1998	0	21	25	49	123	349	136	40	1	0	0	0	0	0	0	0
1/1999	10	74	136	142	161	125	83	13	0	0	0	0	0	0	0	0
2/1999	0	4	39	81	172	289	85	2	0	0	0	0	0	0	0	0
3/1999	0	0	0	57	62	287	261	64	12	1	0	0	0	0	0	0
4/1999	0	0	0	0	0	123	302	205	83	7	0	0	0	0	0	0
5/1999	0	0	0	0	0	9	51	176	244	142	102	20	0	0	0	0
6/1999	0	0	0	0	0	0	2	55	157	253	186	62	5	0	0	0
7/1999	0	0	0	0	0	0	0	2	128	289	213	104	8	0	0	0
8/1999	0	0	0	0	0	0	2	38	203	275	183	43	0	0	0	0
9/1999	0	0	0	0	0	0	19	75	255	196	132	35	8	0	0	0
10/1999	0	0	0	0	4	105	262	228	135	10	0	0	0	0	0	0
11/1999	0	0	0	0	25	267	207	145	66	10	0	0	0	0	0	0
12/1999	0	0	22	116	136	257	183	30	0	0	0	0	0	0	0	0
1/2000	3	59	146	160	130	189	51	6	0	0	0	0	0	0	0	0
2/2000	0	31	54	175	170	153	80	33	0	0	0	0	0	0	0	0
3/2000	0	0	7	23	73	293	211	123	14	0	0	0	0	0	0	0
4/2000	0	0	0	0	8	150	340	169	40	10	3	0	0	0	0	0
5/2000	0	0	0	0	0	15	106	300	205	98	20	0	0	0	0	0
6/2000	0	0	0	0	0	0	28	111	224	198	133	26	0	0	0	0
7/2000	0	0	0	0	0	0	0	10	262	298	141	33	0	0	0	0
8/2000	0	0	0	0	0	0	0	34	220	306	172	12	0	0	0	0
9/2000	0	0	0	0	0	12	64	167	259	167	44	7	0	0	0	0
10/2000	0	0	0	0	4	109	228	238	98	62	5	0	0	0	0	0
11/2000	0	0	0	13	52	198	278	164	15	0	0	0	0	0	0	0
12/2000	0	0	83	170	237	219	21	4	10	0	0	0	0	0	0	0
1/2001	0	9	100	207	277	151	0	0	0	0	0	0	0	0	0	0
2/2001	0	14	98	144	202	190	23	1	0	0	0	0	0	0	0	0
3/2001	12	25	15	47	101	407	121	16	0	0	0	0	0	0	0	0
4/2001	0	0	0	0	14	262	222	143	61	16	2	0	0	0	0	0
5/2001	0	0	0	0	0	6	61	246	190	121	95	25	0	0	0	0
6/2001	0	0	0	0	0	0	0	69	179	241	147	66	18	0	0	0
7/2001	0	0	0	0	0	0	0	27	220	274	151	69	3	0	0	0
8/2001	0	0	0	0	0	0	4	21	125	263	195	111	25	0	0	0
9/2001	0	0	0	0	0	6	43	126	217	237	71	17	3	0	0	0
10/2001	0	0	0	0	0	67	180	232	176	77	12	0	0	0	0	0
11/2001	0	0	0	0	17	275	208	172	44	4	0	0	0	0	0	0
12/2001	0	0	0	19	147	379	135	57	7	0	0	0	0	0	0	0
1/2002	0	0	20	147	243	314	20	0	0	0	0	0	0	0	0	0
2/2002	0	11	48	158	158	161	128	8	0	0	0	0	0	0	0	0
3/2002	0	0	0	59	163	322	150	43	7	0	0	0	0	0	0	0
4/2002	0	0	0	0	6	161	305	183	54	11	0	0	0	0	0	0
5/2002	0	0	0	0	0	18	176	227	187	85	51	0	0	0	0	0
6/2002	0	0	0	0	0	2	21	150	232	176	113	26	0	0	0	0
7/2002	0	0	0	0	0	0	0	29	166	283	199	54	13	0	0	0
8/2002	0	0	0	0	0	0	1	34	152	246	203	85	23	0	0	0
9/2002	0	0	0	0	0	1	28	133	207	241	70	26	14	0	0	0
10/2002	0	0	0	0	9	179	263	169	78	20	26	0	0	0	0	0
11/2002	0	0	0	17	87	392	154	38	25	7	0	0	0	0	0	0
12/2002	0	6	12	139	194	337	56	0	0	0	0	0	0	0	0	0
1/2003	0	67	217	229	192	39	0	0	0	0	0	0	0	0	0	0
2/2003	30	94	98	108	144	177	21	0	0	0	0	0	0	0	0	0
3/2003	3	24	57	71	123	229	193	44	0	0	0	0	0	0	0	0
4/2003	0	0	0	9	110	160	229	138	47	23	4	0	0	0	0	0
5/2003	0	0	0	0	0	20	119	273	200	94	17	21	0	0	0	0
6/2003	0	0	0	0	0	0	19	99	213	190	135	43	21	0	0	0
7/2003	0	0	0	0	0	0	0	4	166	302	228	44	0	0	0	0
8/2003	0	0	0	0	0	0	0	53	109	317	204	61	0	0	0	0
9/2003	0	0	0	0	0	0	21	104	261	253	75	6	0	0	0	0
10/2003	0	0	0	0	0	84	228	264	129	30	9	0	0	0	0	0
11/2003	0	0	0	0	53	269	300	67	24	7	0	0	0	0	0	0
12/2003	0	5	17	109	241	246	87	39	0	0	0	0	0	0	0	0
1/2004	59	144	118	176	193	49	5	0	0	0	0	0	0	0	0	0
2/2004	8	17	44	122	222	248	35	0	0	0	0	0	0	0	0	0
3/2004	0	0	4	59	110	333	204	34	0	0	0	0	0	0	0	0
4/2004	0	0	0	0	10	171	293	165	59	12	4	6	0	0	0	0
5/2004	0	0	0	0	0	13	83	334	170	105	30	9	0	0	0	0
6/2004	0	0	0	0	0	0	25	143	248	212	69	23	0	0	0	0
7/2004	0	0	0	0	0	0	0	25	173	358	152	36	0	0	0	0
8/2004	0	0	0	0	0	0	1	33	170	335	173	32	0	0	0	0
9/2004	0	0	0	1	1	1	48	150	253	203	63	0	0	0	0	0
10/2004	0	0	0	0	0	73	159	318	147	40	7	0	0	0	0	0
11/2004	0	0	0	0	48	322	280	64	6	0	0	0	0	0	0	0
12/2004	0	8	52	191	199	240	39	12	3	0	0	0	0	0	0	0
1/2005	9	83	148	182	174	113	31	4	0	0	0	0	0	0	0	0
2/2005	0	16	65	123	197	191	67	13	0	0	0	0	0	0	0	0
3/2005	1	12	18	65	156	290	173	29	0	0	0	0	0	0	0	0
4/2005	0	0	0	0	3	116	331	155	93	22	0	0	0	0	0	0
5/2005	0	0	0	0	0	14	139	363	193	26	9	0	0	0	0	0
6/2005	0	0	0	0	0	0	3	131	138	187	160	94	7	0	0	0
7/2005	0	0	0	0	0	0	0	24	152	253	220	95	0	0	0	0

Reliability Summary

Project: MQP_07_08

Reliability Summary

Performance Criteria	Distress Target	Reliability Target	Distress Predicted	Reliability Predicted	Acceptable
Terminal IRI (in/mi)	172	90	110	97.9	Pass
AC Surface Down Cracking (Long. Cracking) (ft/mile):	2000	90	31.3	95.56	Pass
AC Bottom Up Cracking (Alligator Cracking) (%):	25	90	0	99.999	Pass
AC Thermal Fracture (Transverse Cracking) (ft/mi):	1000	90	1	99.999	Pass
Chemically Stabilized Layer (Fatigue Fracture)	25	90			N/A
Permanent Deformation (AC Only) (in):	0.25	90	0.07	99.999	Pass
Permanent Deformation (Total Pavement) (in):	0.75	90	0.34	99.999	Pass

(3) Distress Summary

Predicted distress: Project MQP_07_08

Pavement age		Month	Longitudinal Cracking (ft/mi)	Alligator Cracking (%)	Transverse Cracking (ft/mi)	Subtotal AC Rutting (in)	Total Rutting (in)	IRI (in/mi)	Heavy Trucks (cumulative)	IRI at Reliability (in/mi)
mo	yr									
1	0.08	October	0	0	0	1	4	223	5250	286.69
2	0.17	November	0.01	0	0	0.002	0.117	67.7	10501	91.85
3	0.25	December	0.01	0	0	0.003	0.138	68.6	15751	93.03
4	0.33	January	0.01	0	0	0.003	0.152	69.1	21002	93.85
5	0.42	February	0.01	0	0	0.003	0.153	69.2	26252	93.97
6	0.5	March	0.02	0	0	0.003	0.153	69.3	31503	94.02
7	0.58	April	0.05	0	0	0.003	0.153	69.3	36753	94.08
8	0.67	May	0.1	0	0	0.005	0.167	69.9	42004	94.95
9	0.75	June	0.21	0	0	0.007	0.182	70.5	47254	95.85
10	0.83	July	0.31	0	0	0.011	0.191	70.9	52505	96.41
11	0.92	August	0.36	0	0	0.014	0.196	71.2	57755	96.77
12	1	September	0.4	0	0	0.016	0.201	71.4	63006	97.06
13	1.08	October	0.42	0	0	0.016	0.204	71.6	68466	97.3
14	1.17	November	0.43	0	0	0.016	0.207	71.7	73927	97.53
15	1.25	December	0.43	0	0	0.016	0.209	71.9	79387	97.74
16	1.33	January	0.43	0	0	0.016	0.21	72	84848	97.88
17	1.42	February	0.44	0	0	0.016	0.21	72.1	90308	97.98
18	1.5	March	0.46	0	0	0.016	0.211	72.1	95769	98.07
19	1.58	April	0.55	0	0	0.016	0.212	72.2	101229	98.21
20	1.67	May	0.7	0	0	0.017	0.218	72.5	106690	98.65
21	1.75	June	0.81	0	0	0.018	0.223	72.8	112150	99.01
22	1.83	July	0.91	0	0	0.019	0.226	73	117611	99.25
23	1.92	August	0.99	0	0	0.021	0.228	73.1	123071	99.46
24	2	September	1.04	0	0	0.022	0.23	73.3	128531	99.67
25	2.08	October	1.06	0	0	0.022	0.232	73.4	134202	99.86
26	2.17	November	1.08	0	0	0.023	0.233	73.5	139872	100.04
27	2.25	December	1.1	0	0	0.023	0.235	73.7	145543	100.23
28	2.33	January	1.11	0	0	0.023	0.236	73.8	151214	100.4
29	2.42	February	1.11	0	0	0.023	0.236	73.9	156884	100.51
30	2.5	March	1.14	0	0	0.023	0.236	73.9	162555	100.62
31	2.58	April	1.24	0	0	0.023	0.237	74	168225	100.75
32	2.67	May	1.43	0	0	0.023	0.241	74.3	173896	101.07

33	2.75	June	1.62	0	0	0.024	0.244	74.5	179566	101.35
34	2.83	July	1.75	0	0	0.025	0.246	74.6	185237	101.57
35	2.92	August	1.84	0	0	0.027	0.247	74.8	190907	101.77
36	3	September	1.91	0	0	0.027	0.249	74.9	196578	101.95
37	3.08	October	1.94	0	0	0.028	0.25	75	202458	102.14
38	3.17	November	1.98	0	0	0.028	0.251	75.1	208339	102.31
39	3.25	December	2	0	0	0.028	0.252	75.3	214219	102.5
40	3.33	January	2	0	0	0.028	0.253	75.4	220100	102.67
41	3.42	February	2.03	0	0	0.028	0.253	75.5	225980	102.79
42	3.5	March	2.08	0	0	0.028	0.253	75.6	231861	102.91
43	3.58	April	2.18	0	0	0.028	0.254	75.7	237741	103.06
44	3.67	May	2.37	0	0	0.028	0.257	75.9	243622	103.37
45	3.75	June	2.62	0	0	0.029	0.26	76.1	249502	103.64
46	3.83	July	2.78	0	0	0.03	0.261	76.2	255383	103.84
47	3.92	August	2.9	0	0	0.031	0.262	76.4	261263	104.04
48	4	September	2.97	0	0	0.031	0.263	76.5	267144	104.22
49	4.08	October	3.01	0	0	0.031	0.264	76.6	273234	104.4
50	4.17	November	3.04	0	0	0.031	0.265	76.8	279325	104.58
51	4.25	December	3.04	0	0	0.032	0.266	76.9	285415	104.76
52	4.33	January	3.04	0	0	0.032	0.266	77	291506	104.91
53	4.42	February	3.04	0	0	0.032	0.266	77.1	297597	105.04
54	4.5	March	3.07	0	0	0.032	0.266	77.2	303687	105.18
55	4.58	April	3.23	0	0	0.032	0.266	77.3	309778	105.32
56	4.67	May	3.6	0	0	0.032	0.267	77.4	315868	105.51
57	4.75	June	3.89	0	0	0.033	0.269	77.6	321959	105.8
58	4.83	July	4.08	0	0	0.034	0.271	77.8	328049	106.04
59	4.92	August	4.21	0	0	0.035	0.272	77.9	334140	106.23
60	5	September	4.29	0	0	0.035	0.273	78.1	340230	106.42
61	5.08	October	4.33	0	0	0.036	0.274	78.2	346531	106.61
62	5.17	November	4.36	0	0	0.036	0.274	78.3	352832	106.79
63	5.25	December	4.38	0	0	0.036	0.275	78.5	359132	106.97
64	5.33	January	4.38	0	0	0.036	0.276	78.6	365433	107.16
65	5.42	February	4.4	0	0	0.036	0.276	78.7	371733	107.31
66	5.5	March	4.43	0	0	0.036	0.276	78.8	378034	107.47
67	5.58	April	4.57	0	0	0.036	0.276	78.9	384334	107.64
68	5.67	May	4.79	0	0	0.036	0.278	79.1	390635	107.89
69	5.75	June	5.04	0	0	0.036	0.279	79.3	396935	108.12
70	5.83	July	5.22	0	0	0.037	0.28	79.4	403236	108.32
71	5.92	August	5.37	0	0	0.038	0.281	79.6	409537	108.52
72	6	September	5.47	0	0	0.038	0.281	79.7	415837	108.72
73	6.08	October	5.51	0	0	0.039	0.282	79.9	422348	108.92
74	6.17	November	5.55	0	0	0.039	0.283	80	428858	109.1
75	6.25	December	5.55	0	0	0.039	0.283	80.1	435369	109.3
76	6.33	January	5.55	0	0	0.039	0.283	80.3	441879	109.47
77	6.42	February	5.56	0	0	0.039	0.284	80.4	448390	109.64
78	6.5	March	5.6	0	0	0.039	0.284	80.5	454901	109.8
79	6.58	April	5.74	0	0	0.039	0.284	80.6	461411	109.97
80	6.67	May	6	0	0	0.039	0.285	80.8	467922	110.19
81	6.75	June	6.34	0	0	0.039	0.287	81	474432	110.47
82	6.83	July	6.57	0	0	0.04	0.288	81.2	480943	110.71
83	6.92	August	6.7	0	0	0.041	0.289	81.3	487454	110.91
84	7	September	6.8	0	0	0.041	0.289	81.5	493964	111.12
85	7.08	October	6.84	0	0	0.042	0.29	81.6	500685	111.31
86	7.17	November	6.89	0	0	0.042	0.29	81.7	507405	111.51
87	7.25	December	6.9	0	0	0.042	0.291	81.9	514126	111.71
88	7.33	January	6.9	0	0	0.042	0.291	82	520846	111.9
89	7.42	February	6.91	0	0	0.042	0.291	82.2	527567	112.08
90	7.5	March	6.97	0	0	0.042	0.291	82.3	534288	112.26
91	7.58	April	7.18	0	0	0.042	0.291	82.4	541008	112.43
92	7.67	May	7.51	0	0	0.042	0.292	82.6	547729	112.68
93	7.75	June	7.85	0	0	0.042	0.294	82.8	554449	112.94
94	7.83	July	8.12	0	0	0.043	0.295	82.9	561170	113.17
95	7.92	August	8.31	0	0	0.044	0.295	83.1	567891	113.38
96	8	September	8.43	0	0	0.044	0.296	83.3	574611	113.59
97	8.08	October	8.48	0	0	0.044	0.296	83.4	581542	113.8
98	8.17	November	8.54	0	0	0.044	0.297	83.6	588473	114.01
99	8.25	December	8.54	0	0	0.044	0.297	83.7	595403	114.21
100	8.33	January	8.54	0	0	0.044	0.298	83.8	602334	114.4
101	8.42	February	8.57	0	0	0.044	0.298	84	609264	114.59
102	8.5	March	8.62	0	0	0.044	0.298	84.1	616195	114.77

103	8.58	April	8.8	0	0	0.044	0.298	84.3	623126	114.96
104	8.67	May	8.96	0	0	0.045	0.299	84.4	630056	115.21
105	8.75	June	9.31	0	0	0.045	0.3	84.6	636987	115.47
106	8.83	July	9.56	0	0	0.046	0.301	84.8	643917	115.69
107	8.92	August	9.75	0	0	0.046	0.301	85	650848	115.92
108	9	September	9.86	0	0	0.047	0.302	85.1	657779	116.13
109	9.08	October	9.9	0	0	0.047	0.302	85.3	664919	116.35
110	9.17	November	9.94	0	0	0.047	0.303	85.4	672060	116.56
111	9.25	December	10	0	0	0.047	0.303	85.6	679201	116.77
112	9.33	January	10	0	0	0.047	0.303	85.7	686341	116.99
113	9.42	February	10	0	0	0.047	0.303	85.9	693482	117.19
114	9.5	March	10.1	0	0	0.047	0.303	86	700623	117.38
115	9.58	April	10.2	0	0	0.047	0.303	86.2	707763	117.58
116	9.67	May	10.5	0	0	0.047	0.304	86.3	714904	117.82
117	9.75	June	10.9	0	0	0.047	0.305	86.5	722044	118.07
118	9.83	July	11.1	0	0	0.048	0.306	86.7	729185	118.32
119	9.92	August	11.3	0	0	0.049	0.307	86.9	736326	118.55
120	10	September	11.4	0	0	0.049	0.307	87	743466	118.77
121	10.1	October	11.4	0	0	0.049	0.308	87.2	750817	118.99
122	10.2	November	11.5	0	0	0.049	0.308	87.4	758168	119.21
123	10.3	December	11.5	0	0	0.049	0.308	87.5	765518	119.42
124	10.3	January	11.5	0	0	0.049	0.308	87.7	772869	119.64
125	10.4	February	11.5	0	0	0.049	0.308	87.8	780220	119.84
126	10.5	March	11.6	0	0	0.049	0.308	88	787570	120.04
127	10.6	April	11.8	0	0	0.049	0.309	88.1	794921	120.25
128	10.7	May	12.2	0	0	0.049	0.31	88.3	802272	120.52
129	10.8	June	12.4	0	0	0.05	0.311	88.5	809622	120.77
130	10.8	July	12.7	0	0	0.05	0.311	88.7	816973	121.01
131	10.9	August	12.9	0	0	0.051	0.312	88.9	824324	121.24
132	11	September	13	0	0	0.051	0.312	89	831674	121.47
133	11.1	October	13	0	0	0.051	0.312	89.2	839235	121.69
134	11.2	November	13.1	0	0	0.051	0.313	89.4	846796	121.92
135	11.3	December	13.1	0	0	0.051	0.313	89.5	854356	122.15
136	11.3	January	13.1	0	0	0.051	0.313	89.7	861917	122.38
137	11.4	February	13.1	0	0	0.051	0.313	89.9	869478	122.59
138	11.5	March	13.2	0	0	0.051	0.313	90	877038	122.8
139	11.6	April	13.4	0	0	0.051	0.313	90.2	884599	123.02
140	11.7	May	13.8	0	0	0.051	0.314	90.4	892160	123.29
141	11.8	June	14.2	0	0	0.052	0.315	90.6	899720	123.55
142	11.8	July	14.4	0	0	0.052	0.316	90.8	907281	123.79
143	11.9	August	14.6	0	0	0.053	0.316	90.9	914842	124.02
144	12	September	14.7	0	0	0.053	0.316	91.1	922402	124.26
145	12.1	October	14.8	0	0	0.054	0.317	91.3	930173	124.49
146	12.2	November	14.9	0	0	0.054	0.317	91.5	937944	124.73
147	12.3	December	14.9	0	0	0.054	0.317	91.6	945714	124.96
148	12.3	January	14.9	0	0	0.054	0.318	91.8	953485	125.19
149	12.4	February	15	0	0	0.054	0.318	92	961256	125.41
150	12.5	March	15.1	0	0	0.054	0.318	92.1	969027	125.64
151	12.6	April	15.3	0	0	0.054	0.318	92.3	976797	125.86
152	12.7	May	15.6	0	0	0.054	0.319	92.5	984568	126.15
153	12.8	June	16.1	0	0	0.054	0.32	92.7	992339	126.41
154	12.8	July	16.3	0	0	0.055	0.32	92.9	1000110	126.66
155	12.9	August	16.5	0	0	0.055	0.321	93.1	1007880	126.9
156	13	September	16.7	0	0	0.055	0.321	93.3	1015650	127.14
157	13.1	October	16.7	0	0	0.055	0.321	93.4	1023630	127.38
158	13.2	November	16.8	0	0	0.055	0.322	93.6	1031610	127.62
159	13.3	December	16.8	0	0	0.055	0.322	93.8	1039590	127.86
160	13.3	January	16.8	0	0	0.055	0.322	94	1047570	128.09
161	13.4	February	16.8	0	0	0.055	0.322	94.1	1055550	128.32
162	13.5	March	16.9	0	0	0.055	0.322	94.3	1063530	128.55
163	13.6	April	17.1	0	0	0.055	0.322	94.5	1071520	128.77
164	13.7	May	17.7	0	0	0.055	0.322	94.7	1079500	129.02
165	13.8	June	18.2	0	0	0.056	0.323	94.9	1087480	129.31
166	13.8	July	18.5	0	0	0.057	0.324	95.1	1095460	129.57
167	13.9	August	18.7	0	0	0.057	0.324	95.3	1103440	129.82
168	14	September	18.9	0	0	0.058	0.325	95.5	1111420	130.07
169	14.1	October	18.9	0	0	0.058	0.325	95.6	1119610	130.31
170	14.2	November	19	0	0	0.058	0.325	95.8	1127800	130.56
171	14.3	December	19	0	0	0.058	0.325	96	1135990	130.81
172	14.3	January	19	0	0	0.058	0.326	96.2	1144180	131.05

173	14.4	February	19.1	0	0	0.058	0.326	96.4	1152370	131.28
174	14.5	March	19.1	0	0	0.058	0.326	96.5	1160560	131.52
175	14.6	April	19.3	0	0	0.058	0.326	96.7	1168750	131.76
176	14.7	May	19.7	0	0	0.058	0.327	96.9	1176950	132.04
177	14.8	June	20.1	0	0	0.058	0.327	97.1	1185140	132.3
178	14.8	July	20.3	0	0	0.059	0.327	97.3	1193330	132.56
179	14.9	August	20.6	0	0	0.059	0.328	97.5	1201520	132.81
180	15	September	20.7	0	0	0.059	0.328	97.7	1209710	133.07
181	15.1	October	20.8	0	0	0.06	0.328	97.9	1218110	133.32
182	15.2	November	20.9	0	0	0.06	0.329	98.1	1226510	133.57
183	15.3	December	20.9	0	0	0.06	0.329	98.3	1234910	133.82
184	15.3	January	20.9	0	0	0.06	0.329	98.5	1243310	134.06
185	15.4	February	20.9	0	0	0.06	0.329	98.7	1251710	134.31
186	15.5	March	20.9	0	0	0.06	0.329	98.8	1260110	134.55
187	15.6	April	21.1	0	0	0.06	0.329	99	1268510	134.79
188	15.7	May	21.5	0	0	0.06	0.329	99.2	1276910	135.06
189	15.8	June	22	0	0	0.06	0.33	99.4	1285310	135.36
190	15.8	July	22.4	0	0	0.06	0.331	99.7	1293720	135.63
191	15.9	August	22.6	0	0	0.061	0.331	99.9	1302120	135.89
192	16	September	22.7	0	0	0.061	0.332	100	1310520	136.15
193	16.1	October	22.8	0	0	0.061	0.332	100.2	1319130	136.41
194	16.2	November	22.9	0	0	0.061	0.332	100.4	1327740	136.66
195	16.3	December	22.9	0	0	0.061	0.332	100.6	1336350	136.92
196	16.3	January	22.9	0	0	0.061	0.332	100.8	1344960	137.17
197	16.4	February	22.9	0	0	0.061	0.332	101	1353570	137.42
198	16.5	March	23	0	0	0.061	0.332	101.2	1362180	137.67
199	16.6	April	23.3	0	0	0.061	0.332	101.4	1370790	137.92
200	16.7	May	23.8	0	0	0.062	0.333	101.6	1379400	138.2
201	16.8	June	24.3	0	0	0.062	0.334	101.8	1388010	138.49
202	16.8	July	24.7	0	0	0.062	0.334	102	1396620	138.76
203	16.9	August	24.9	0	0	0.063	0.335	102.2	1405240	139.03
204	17	September	25.1	0	0	0.063	0.335	102.4	1413850	139.29
205	17.1	October	25.2	0	0	0.063	0.335	102.6	1422670	139.56
206	17.2	November	25.2	0	0	0.063	0.335	102.8	1431490	139.82
207	17.3	December	25.3	0	0	0.063	0.336	103	1440310	140.08
208	17.3	January	25.3	0	0	0.063	0.336	103.2	1449130	140.34
209	17.4	February	25.3	0	0	0.063	0.336	103.4	1457950	140.59
210	17.5	March	25.4	0	0	0.063	0.336	103.6	1466770	140.84
211	17.6	April	25.6	0	0	0.063	0.336	103.8	1475590	141.1
212	17.7	May	25.9	0	0	0.063	0.336	104	1484410	141.38
213	17.8	June	26.3	0	0	0.063	0.337	104.3	1493230	141.67
214	17.8	July	26.7	0	0	0.064	0.337	104.5	1502050	141.95
215	17.9	August	27	0	0	0.064	0.338	104.7	1510870	142.22
216	18	September	27.1	0	0	0.065	0.338	104.9	1519700	142.49
217	18.1	October	27.2	0	0	0.065	0.338	105.1	1528730	142.75
218	18.2	November	27.2	0	0	0.065	0.338	105.3	1537760	143.02
219	18.3	December	27.3	0	0	0.065	0.338	105.5	1546790	143.29
220	18.3	January	27.3	0	0	0.065	0.339	105.7	1555820	143.56
221	18.4	February	27.3	0	0	0.065	0.339	105.9	1564850	143.82
222	18.5	March	27.4	0	0	0.065	0.339	106.1	1573880	144.08
223	18.6	April	27.6	0	0	0.065	0.339	106.3	1582910	144.34
224	18.7	May	28	0	0	0.065	0.339	106.5	1591940	144.63
225	18.8	June	28.5	0	0	0.065	0.34	106.8	1600970	144.92
226	18.8	July	28.9	0	0	0.066	0.34	107	1610000	145.2
227	18.9	August	29.1	0	0	0.066	0.341	107.2	1619030	145.48
228	19	September	29.2	0	0	0.066	0.341	107.4	1628070	145.75
229	19.1	October	29.3	0	0	0.066	0.341	107.6	1637310	146.02
230	19.2	November	29.3	0	0	0.066	0.341	107.8	1646550	146.29
231	19.3	December	29.3	0	0	0.066	0.341	108	1655790	146.57
232	19.3	January	29.3	0	0	0.066	0.341	108.2	1665030	146.84
233	19.4	February	29.4	0	0	0.066	0.341	108.5	1674270	147.1
234	19.5	March	29.4	0	0	0.066	0.341	108.7	1683510	147.37
235	19.6	April	29.8	0	0	0.066	0.342	108.9	1692750	147.64
236	19.7	May	30.3	0	0	0.067	0.342	109.1	1701990	147.93
237	19.8	June	30.6	0	0	0.067	0.343	109.3	1711230	148.22
238	19.8	July	30.9	0	0	0.067	0.343	109.5	1720470	148.51
239	19.9	August	31.2	0	0	0.067	0.343	109.8	1729710	148.79
240	20	September	31.3	0	0	0.068	0.343	110	1738960	149.07

Layers Modulus

Subseason Layer Modulus: Project MQP_07_08

Pavement			Modulus (psi)																					
age			AC1 (1) h=0.5					AC1 (2) h=0.5					GB2 (3)	GB3 (4)	NSG4 (5)	NSG4 (6)	NSG4 (7)	NSG4 (8)	NSG4 (9)	Bed1 (1)	CTB1 (1)
mo	yr	Month	1	2	3	4	5	1	2	3	4	5	h=1.0	h=1.0	h=2.0	h=4.0	h=24.2	h=24.2	h=24.2	h=24.2	h=248.1
2	0.17	November	3216020	2723250	1895030	4291940	4291940	2744440	2341010	1687570	4126310	4126310	44794	31880	9690	9500	9500	9500	9500	0	0
3	0.25	December	4291940	4291940	3873150	4291940	4291940	4126310	4126310	3498340	4126310	4126310	101107	19093	9709	9500	9500	9500	9500	0	0
4	0.33	January	4291940	4291940	4254090	4291940	4291940	4126310	4126310	3816860	4126310	4126310	1000020	999998	16682	9500	9500	9500	9500	0	0
5	0.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	93708	9500	9500	9500	9500	0	0
6	0.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	530994	502921	2500000	9500	9500	9500	9500	0	0
7	0.58	April	4291940	4291940	3783670	4291940	4291940	4126310	4126310	3518950	4126310	4126310	47777	15834	36860	8873	9500	9500	9500	0	0
8	0.67	May	3915310	2765670	1593800	4291940	3792370	3391270	2350190	1397710	4126310	3232980	46080	18977	8265	9215	9500	9500	9500	0	0
9	0.75	June	2922950	2075250	1124620	3406110	2104900	2410030	1720210	997478	2742020	1665930	58937	24050	9082	9424	9500	9500	9500	0	0
10	0.83	July	1378010	865875	565023	2635880	1849160	1144050	762937	504698	2046660	1459920	71691	29103	9652	9500	9500	9500	9500	0	0
11	0.92	August	1267530	795513	511754	2931740	2157250	1047940	697911	454792	2303250	1698120	82491	32863	9690	9500	9500	9500	9500	0	0
12	1	September	1555220	1011060	591579	4291940	3068260	1260130	867982	526549	3705700	2488980	87685	33442	9709	9500	9500	9500	9500	0	0
13	1.08	October	2327420	1693990	965243	4291940	4281620	1861170	1393790	845189	4126310	3701840	88302	33538	9709	9500	9500	9500	9500	0	0
14	1.17	November	4291940	4135360	2410550	4291940	4291940	4126310	3622670	2041450	4126310	4126310	46440	32632	9709	9500	9500	9500	9500	0	0
15	1.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	148678	36354	9861	9500	9500	9500	9500	0	0
16	1.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	347499	266552	19171	9500	9500	9500	9500	0	0
17	1.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	242792	159650	50008	9500	9500	9500	9500	0	0
18	1.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	89588	29623	25897	9500	9500	9500	9500	0	0
19	1.58	April	4291940	4291940	2782810	4291940	4291940	4126310	4126310	2432700	4126310	4126310	39394	15506	8113	9500	9500	9500	9500	0	0
20	1.67	May	3867920	2552240	1136780	4291940	3228000	3333890	2115810	999142	3755440	2616490	54925	21678	8930	9500	9500	9500	9500	0	0
21	1.75	June	2347430	1424060	710834	3818080	2485450	1871320	1182650	629002	3171830	1968880	67474	26711	9538	9500	9500	9500	9500	0	0
22	1.83	July	1852710	1322370	699618	2954790	2041970	1478150	1093880	612339	2303010	1577930	78582	31417	9690	9500	9500	9500	9500	0	0
23	1.92	August	1373250	838687	536916	3260940	2225210	1107320	720268	463898	2567800	1719470	82131	32806	9690	9500	9500	9500	9500	0	0
24	2	September	1490340	915032	560095	4291940	3143440	1194110	783634	487778	3698220	2533630	82593	32863	9690	9500	9500	9500	9500	0	0
25	2.08	October	2437480	1738800	1005150	4291940	4291940	1943630	1415400	868926	4126310	4126310	83005	32902	9690	9500	9500	9500	9500	0	0
26	2.17	November	4291940	3681960	2167860	4291940	4291940	4126310	3200000	1806370	4126310	4126310	81976	32806	9690	9500	9500	9500	9500	0	0
27	2.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	47828	24609	9690	9500	9500	9500	9500	0	0
28	2.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	24738	9500	9500	9500	9500	0	0
29	2.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	170792	163642	62320	9500	9500	9500	9500	0	0
30	2.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	72976	29006	45182	9500	9500	9500	9500	0	0
31	2.58	April	4291940	4291940	3159060	4291940	4291940	4126310	4126310	2818310	4126310	4126310	37388	15988	8075	9500	9500	9500	9500	0	0
32	2.67	May	4272760	2856600	1578040	4291940	3391470	3770810	2419880	1342590	4126310	2768380	53177	22198	8911	9500	9500	9500	9500	0	0
33	2.75	June	2370350	1361890	688710	3402770	2091740	1881490	1133030	606131	2694910	1613720	66239	27348	9519	9500	9500	9500	9500	0	0
34	2.83	July	1342910	852279	551669	2960760	1913410	1076230	728440	474750	2299860	1469560	79611	32053	9690	9500	9500	9500	9500	0	0
35	2.92	August	1318980	826225	531439	3630140	2379130	1061770	701454	453914	2944630	1842720	84033	33056	9690	9500	9500	9500	9500	0	0
36	3	September	1617250	1032740	625671	4291940	3030340	1280530	867756	538367	3669580	2422690	83673	33037	9690	9500	9500	9500	9500	0	0
37	3.08	October	2115960	1432400	718627	4291940	4291940	1653510	1163730	624136	4126310	4126310	81668	32786	9690	9500	9500	9500	9500	0	0
38	3.17	November	4291940	4291940	2708560	4291940	4291940	4126310	3911750	2300280	4126310	4126310	40371	29874	9690	9500	9500	9500	9500	0	0
39	3.25	December	4291940	4291940	3675720	4291940	4291940	4126310	4126310	3258390	4126310	4126310	48137	25091	9690	9500	9500	9500	9500	0	0
40	3.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	255494	206109	14858	9500	9500	9500	9500	0	0
41	3.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	9918	9500	9500	9500	0	0
42	3.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	57034	20559	54549	9690	9500	9500	9500	0	0
43	3.58	April	4291940	4291940	2838970	4291940	4291940	4126310	4126310	2529970	4126310	4126310	38365	15988	7676	9082	9500	9500	9500	0	0
44	3.67	May	4291940	4220920	2051760	4291940	4291940	4126310	3801720	1731220	4126310	3739750	44640	22025	8683	9386	9500	9500	9500	0	0
45	3.75	June	3211690	2082600	981439	4253760	2742940	2646230	1693130	852303	3608290	2159630	56057	26923	9481	9500	9500	9500	9500	0	0
46	3.83	July	1827950	1061730	636679	3454940	2422270	1443440	890693	548790	2783880	1883370	68142	31533	9671	9500	9500	9500	9500	0	0
47	3.92	August	1637080	1070290	637156	3748660	2549660	1290870	897263	547334	3076520	1990850	77759	32458	9671	9500	9500	9500	9500	0	0
48	4	September	1785700	1127480	731530	4291940	3817440	1397830	939113	632642	4126310	3195320	78685	32458	9671	9500	9500	9500	9500	0	0
49	4.08	October	2695850	1875720	960830	4291940	4291940	2150150	1520100	825351	4126310	4126310	81153	32690	9690	9500	9500	9500	9500	0	0
50	4.17	November	4291940	4252070	2184180	4291940	4291940	4126310	3747250	1831370	4126310	4126310	81616	32748	9690	9500	9500	9500	9500	0	0
51	4.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	368687	84338	11571	9500	9500	9500	9500	0	0
52	4.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	29906	9500	9500	9500	9500	0	0
53	4.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	9690	9500	9500	9500	0	0
54	4.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	469178	779945	2500000	12654	9500	9500	9500	0	0
55	4.58	April	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	50554	17261	41895	12331	9500	9500	9500	0	0
56	4.67	May	4291940	2487130	1209150	4291940	3927980	4126310	2099580	1059240	4126310	3293340	44948	19787	8170	9063	9500	9500	9500	0	0
57	4.75	June	2641680	1383190	666598	3636770	2382320	2111330	1141760	581034	2977580	1856640	58988	24995	8987	9310	9500	9500	9500	0	0
58	4.83	July	1627500	982927	555284	3474870	2320850	1280620	821928	471542	2786710	1796480	72154	30086	9633	9481	9500	9500	9500	0	0
59	4.92	August	1567900	1000790	614706	3464290	2260920	1240600	841889	524182	2747060	1730470	84548	33288	9709	9500	9500	9500	9500	0	0
60	5	September	1432030	857322	540908	4291940	3423850	1129360	723849	457524	4126310	2780690	87376	33423	9709	9500	9500	9500	9500	0	0
61	5.08	October	2478800	1590360	846715	4291940	4291940	1957250	1283590	728995	4126310	4126310	86656	33365	9709	9500	9500	9500	9500	0	0
62	5.17	November	4291940	3920820	2338720	4291940	4291940	4126310	3421280	1971150	4126310	4126310	74416	33403	9709	9500	9500	9500	9500	0	0
63	5.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	3939490	4126310	4126310	50194	29430	9709	9500	9500	9500	9500	0	0
64	5.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	484863	750418	12635	9500	9500	9500	9500	0	0
65	5.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	592502	787679	24738	9500	9500	9500	9500	0	0
66	5.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	100182	47386	47500	9500	9500	9500	9500	0	0
67	5.58	April	4291940	4291940	4166900	4291940	4291940	4126310	4126310	4015740	4126310	4126310	37697	15313	8379	9500	9500	9500	9500	0	0
68	5.67	May	4291940	3678500	2006760	4291940	4291940	4126310	3213280	1696380	4126310	4126310	50502	21485	9177	9500	9500	9500	9500	0	0
69	5.75	June	3349620	1972590	931799	4291940	3040490	2795190	1611560	805766	3900570	2426590	62742	26460	9633	9500	9500	9500	9500	0	0
70	5.83	July	2027900	1142340	612978	3520170	2272930	1589340	946635	522479	2799750	1755270	75291	31378	9690	9500	9500	9500	9500	0	0
71	5.92	August	1547600	981812	588161	3615020	2327220	1223100	819107	499134	2892560	1781950	83776	33037	9690	9500	9500	9500	9500	0	0
72	6	September	1472610	853154	560731	4291940	3451040	1152660	721108	474513	4126310	2821370	84188	33056	9690	9500	9500	9500	9500	0	0
73	6.08	October	2483190	1569110	801056	4291940	4291940	1949610	1265080	690097	4126310	4126310	83828	33037	9690	9500	9500	9500	9500	0	0
74	6.17	November	4291940	4291940	4031840	4291940	4291940	4126310	4126310	3647740	4126310	4126310	53279	26595	9690	9500	9500	9500	9500	0	0
75	6.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	606182	212995	12825	9500	9500	9500	9500	0	0

76	6.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	20520	9500	9500	9500	9500	0	0
77	6.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	12654	9500	9500	9500	0	0
78	6.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	374859	443674	2500000	12654	9500	9500	9500	0	0
79	6.58	April	4291940	4291940	4242360	4291940	4291940	4126310	4126310	3973420	4126310	4126310	64748	24956	31616	12654	9500	9500	9500	0	0
80	6.67	May	4291940	3700780	1636490	4291940	4291940	4126310	3304550	1393450	4126310	4035430	46594	18977	8208	8987	9500	9500	9500	0	0
81	6.75	June	3353530	2137110	948400	4291940	2802830	2813690	1734510	815717	3763810	2208060	60582	24204	9044	9234	9500	9500	9500	0	0
82	6.83	July	1851530	978589	530899	3169830	2208990	1441920	820934	447382	2480130	1685510	74108	29334	9652	9462	9500	9500	9500	0	0
83	6.92	August	1426020	856031	593798	3633360	2160360	1125790	717682	503053	2940700	1662790	86553	33268	9709	9500	9500	9500	9500	0	0
84	7	September	1597840	1098110	649866	4291940	3333230	1248870	906949	551815	4126310	2704870	87531	33461	9709	9500	9500	9500	9500	0	0
85	7.08	October	2424100	1525560	829520	4291940	4291940	1907600	1234880	716037	4126310	4126310	87633	33461	9709	9500	9500	9500	9500	0	0
86	7.17	November	4291940	4291940	3276830	4291940	4291940	4126310	4107390	2841110	4126310	4126310	62228	28408	9709	9500	9500	9500	9500	0	0
87	7.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	217643	108021	10868	9500	9500	9500	9500	0	0
88	7.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	113614	13357	9500	9500	9500	9500	0	0
89	7.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	12654	9500	9500	9500	0	0
90	7.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	71176	26306	142823	12654	9500	9500	9500	0	0
91	7.58	April	4291940	4291940	3950360	4291940	4291940	4126310	4126310	3720230	4126310	4126310	39240	15545	14440	10127	9500	9500	9500	0	0
92	7.67	May	4291940	2619680	1200330	4291940	4291940	4126310	2201530	1039420	4126310	3832120	41245	20868	8417	9120	9500	9500	9500	0	0
93	7.75	June	3349400	2054680	898387	4291940	3134180	2779330	1655330	777491	4126310	2499590	53228	25824	9234	9367	9500	9500	9500	0	0
94	7.83	July	2102890	1258370	737901	3382790	2403400	1647400	1038850	634355	2708860	1841920	65776	30723	9671	9500	9500	9500	9500	0	0
95	7.92	August	1591010	1027980	573663	3706440	2438050	1253100	853708	484393	2997390	1870530	76628	32593	9690	9500	9500	9500	9500	0	0
96	8	September	1698200	1035600	648338	4291940	3882930	1317480	862723	549421	4126310	3243820	78068	32420	9671	9500	9500	9500	9500	0	0
97	8.08	October	2750130	1655050	872931	4291940	4291940	2171400	1329960	752717	4126310	4126310	79148	32497	9671	9500	9500	9500	9500	0	0
98	8.17	November	4291940	4274500	2802550	4291940	4291940	4126310	3844630	2390860	4126310	4126310	87685	29932	9690	9500	9500	9500	9500	0	0
99	8.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	278585	92727	10336	9500	9500	9500	9500	0	0
100	8.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	277608	250274	21033	9500	9500	9500	9500	0	0
101	8.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	204272	128175	2500000	10944	9500	9500	9500	0	0
102	8.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	12654	9500	9500	9500	0	0
103	8.58	April	4291940	4291940	3366430	4291940	4291940	4126310	4126310	3126880	4126310	4126310	37131	15622	12065	10754	9500	9500	9500	0	0
104	8.67	May	4291940	3093190	1400750	4291940	4291940	4126310	2625250	1197720	4126310	4126310	51274	21408	8455	9101	9500	9500	9500	0	0
105	8.75	June	3801870	2660060	1430300	4257310	2648880	3259960	2192770	1197480	3625550	2080980	62485	26306	9272	9348	9500	9500	9500	0	0
106	8.83	July	1812340	937802	528503	3387370	2192650	1403220	780603	442916	2683600	1670410	74159	31051	9671	9500	9500	9500	9500	0	0
107	8.92	August	1436980	820341	529879	3617850	2383290	1131790	688368	442946	2892810	1824430	78993	32497	9671	9500	9500	9500	9500	0	0
108	9	September	1632230	1023450	590055	4291940	3985210	1277920	849238	497530	4126310	3385580	79713	32555	9690	9500	9500	9500	9500	0	0
109	9.08	October	3002700	2002580	954467	4291940	4291940	2415000	1595420	813127	4126310	4126310	78531	32458	9671	9500	9500	9500	9500	0	0
110	9.17	November	4291940	4291940	2895940	4291940	4291940	4126310	4126310	2483420	4126310	4126310	77142	31282	9671	9500	9500	9500	9500	0	0
111	9.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	92828	17917	9690	9500	9500	9500	9500	0	0
112	9.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	15599	9500	9500	9500	9500	0	0
113	9.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	73815	9500	9500	9500	9500	0	0
114	9.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	544468	633468	2500000	9500	9500	9500	9500	0	0
115	9.58	April	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	47005	15699	31426	9500	9500	9500	9500	0	0
116	9.67	May	4291940	3755230	1944230	4291940	4291940	4126310	3347050	1654330	4126310	4126310	46645	19016	8284	9500	9500	9500	9500	0	0
117	9.75	June	3916630	2647440	1275210	4291940	2648320	3381820	2180720	1083680	3810610	2058180	60634	24223	9101	9500	9500	9500	9500	0	0
118	9.83	July	1601490	952599	623969	3373270	2242220	1264750	802796	530275	2655150	1709220	74262	29373	9652	9500	9500	9500	9500	0	0
119	9.92	August	1440980	864937	568205	3728920	2650060	1138550	727509	477585	3002900	2059610	85833	33211	9709	9500	9500	9500	9500	0	0
120	10	September	1811470	1115290	646041	4291940	3857740	1414310	917888	549112	4126310	3250690	87839	33481	9709	9500	9500	9500	9500	0	0
121	10.08	October	2854430	1982510	1051830	4291940	4291940	2289160	1593450	886683	4126310	4126310	88302	33538	9709	9500	9500	9500	9500	0	0
122	10.17	November	4291940	4291940	2948730	4291940	4291940	4126310	4126310	2536300	4126310	4126310	46440	32632	9709	9500	9500	9500	9500	0	0
123	10.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	148678	36219	9861	9500	9500	9500	9500	0	0
124	10.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	347499	266629	19171	9500	9500	9500	9500	0	0
125	10.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	242792	158608	49894	9500	9500	9500	9500	0	0
126	10.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	89588	29604	25802	9500	9500	9500	9500	0	0
127	10.58	April	4291940	4291940	3249070	4291940	4291940	4126310	4126310	2936540	4126310	4126310	39394	15506	8113	9500	9500	9500	9500	0	0
128	10.67	May	4291940	2967840	1223650	4291940	3771640	4067380	2500730	1048820	4126310	3144090	54925	21678	8930	9500	9500	9500	9500	0	0
129	10.75	June	2694520	1557770	751007	4291940	2849150	2154520	1262440	646152	3810380	2271800	67474	26711	9538	9500	9500	9500	9500	0	0
130	10.83	July	2070250	1432100	737947	3401380	2291630	1626680	1154380	628449	2696100	1748440	78582	31417	9690	9500	9500	9500	9500	0	0
131	10.92	August	1487290	883428	572150	3743190	2503590	1167830	739954	478007	3016810	1923360	82131	32806	9690	9500	9500	9500	9500	0	0
132	11	September	1620210	964341	593998	4291940	3587110	1267460	806264	501395	4126310	2955400	82593	32863	9690	9500	9500	9500	9500	0	0
133	11.08	October	2747990	1908880	1061300	4291940	4291940	2203080	1532120	897054	4126310	4126310	83005	32902	9690	9500	9500	9500	9500	0	0
134	11.17	November	4291940	4182830	2413450	4291940	4291940	4126310	3743120	2017890	4126310	4126310	81925	32806	9690	9500	9500	9500	9500	0	0
135	11.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	47828	24609	9690	9500	9500	9500	9500	0	0
136	11.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	24757	9500	9500	9500	9500	0	0
137	11.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	170792	161790	62453	9500	9500	9500	9500	0	0
138	11.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	72976	29199	45163	9500	9500	9500	9500	0	0
139	11.58	April	4291940	4291940	3500300	4291940	4291940	4126310	4126310	3191040	4126310	4126310	37388	15988	8075	9500	9500	9500	9500	0	0
140	11.67	May	4291940	3159630	1687510	4291940	3752400	4126310	2721310	1421520	4126310	3124020	53177	22198	8911	9500	9500	9500	9500	0	0

141	11.75	June	2592250	1440690	715725	3753360	2265850	2062350	1179660	617661	3026760	1735790	66239	27348	9519	9500	9500	9500	9500	0	0
142	11.83	July	1417170	884529	577287	3248890	2057250	1115180	742922	485129	2550900	1562270	79611	32053	9690	9500	9500	9500	9500	0	0
143	11.92	August	1388440	856336	556678	3980740	2582010	1098160	714651	464148	3293710	1999880	84033	33056	9690	9500	9500	9500	9500	0	0
144	12	September	1718660	1074420	649827	4291940	3309380	1341730	888004	548312	4089750	2679780	83673	33037	9690	9500	9500	9500	9500	0	0
145	12.08	October	2277830	1509770	743536	4291940	4291940	1771860	1208750	634838	4126310	4126310	81668	32786	9690	9500	9500	9500	9500	0	0
146	12.17	November	4291940	4291940	2941160	4291940	4291940	4126310	4126310	2528790	4126310	4126310	40371	29855	9690	9500	9500	9500	9500	0	0
147	12.25	December	4291940	4291940	3999880	4291940	4291940	4126310	4126310	3614200	4126310	4126310	48137	25091	9690	9500	9500	9500	9500	0	0
148	12.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	261151	205415	14763	9500	9500	9500	9500	0	0
149	12.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	9918	9500	9500	9500	0	0
150	12.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	57034	20617	54397	9690	9500	9500	9500	0	0
151	12.58	April	4291940	4291940	3054590	4291940	4291940	4126310	4126310	2760860	4126310	4126310	38365	15988	7676	9082	9500	9500	9500	0	0
152	12.67	May	4291940	4291940	2177800	4291940	4291940	4126310	4126310	1839790	4126310	4079910	44640	22025	8683	9386	9500	9500	9500	0	0
153	12.75	June	3450870	2208630	1011560	4291940	2932830	2880310	1793610	867791	3931490	2323300	56057	26923	9481	9500	9500	9500	9500	0	0
154	12.83	July	1925210	1095560	655767	3701160	2575990	1508930	907607	556730	3022280	2004890	68142	31533	9671	9500	9500	9500	9500	0	0
155	12.92	August	1714130	1103820	655831	4007870	2711890	1337870	914113	555099	3339240	2123840	77759	32458	9671	9500	9500	9500	9500	0	0
156	13	September	1874320	1163610	750916	4291940	4074130	1455060	957702	641062	4126310	3462280	78685	32458	9671	9500	9500	9500	9500	0	0
157	13.08	October	2867680	1970410	987302	4291940	4291940	2300650	1589820	838464	4126310	4126310	81153	32690	9690	9500	9500	9500	9500	0	0
158	13.17	November	4291940	4291940	2304860	4291940	4291940	4126310	4047560	1937490	4126310	4126310	81616	32748	9690	9500	9500	9500	9500	0	0
159	13.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	368687	84357	11571	9500	9500	9500	9500	0	0
160	13.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	29906	9500	9500	9500	9500	0	0
161	13.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	9690	9500	9500	9500	0	0
162	13.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	469126	780157	2500000	12654	9500	9500	9500	0	0
163	13.58	April	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	50554	17222	41914	12464	9500	9500	9500	0	0
164	13.67	May	4291940	2616680	1243770	4291940	4146260	4126310	2221730	1081120	4126310	3521950	44948	19787	8170	9063	9500	9500	9500	0	0
165	13.75	June	2780390	1427330	681953	3837250	2498300	2232190	1168320	587566	3177950	1948000	58988	24995	8987	9310	9500	9500	9500	0	0
166	13.83	July	1686800	1005610	570443	3662600	2429760	1316660	832721	477769	2967120	1879740	72154	30086	9633	9481	9500	9500	9500	0	0
167	13.92	August	1621970	1023710	629321	3647520	2363130	1272910	853086	530244	2920330	1805440	84548	33288	9709	9500	9500	9500	9500	0	0
168	14	September	1476440	875080	555656	4291940	3601130	1153620	731868	463587	4126310	2953100	87376	33423	9709	9500	9500	9500	9500	0	0
169	14.08	October	2594630	1643700	863860	4291940	4291940	2053000	1317730	736962	4126310	4126310	86656	33365	9709	9500	9500	9500	9500	0	0
170	14.17	November	4291940	4117090	2442310	4291940	4291940	4126310	3652530	2066200	4126310	4126310	74416	33403	9709	9500	9500	9500	9500	0	0
171	14.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	50194	29430	9709	9500	9500	9500	9500	0	0
172	14.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	484863	789800	12654	9500	9500	9500	9500	0	0
173	14.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	592502	787679	24928	9500	9500	9500	9500	0	0
174	14.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	99410	47675	47500	9500	9500	9500	9500	0	0
175	14.58	April	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	37697	15313	8379	9500	9500	9500	9500	0	0
176	14.67	May	4291940	3844060	2078040	4291940	4291940	4126310	3391200	1757430	4126310	4126310	50502	21485	9177	9500	9500	9500	9500	0	0
177	14.75	June	3497480	2040480	948707	4291940	3169870	2943210	1664670	814203	4102780	2544890	62742	26460	9633	9500	9500	9500	9500	0	0
178	14.83	July	2097830	1166000	625008	3670270	2356080	1639800	958966	527483	2942740	1817800	75291	31378	9690	9500	9500	9500	9500	0	0
179	14.92	August	1589420	999551	600053	3766270	2412030	1247870	827567	504057	3038950	1845460	83776	33037	9690	9500	9500	9500	9500	0	0
180	15	September	1509930	867343	572577	4291940	3592860	1173260	727552	479404	4126310	2960550	84188	33056	9690	9500	9500	9500	9500	0	0
181	15.08	October	2575370	1610540	814041	4291940	4291940	2025040	1291350	696002	4126310	4126310	83828	33037	9690	9500	9500	9500	9500	0	0
182	15.17	November	4291940	4291940	4191190	4291940	4291940	4126310	4126310	3826410	4126310	4126310	53279	26711	9690	9500	9500	9500	9500	0	0
183	15.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	606182	212995	12844	9500	9500	9500	9500	0	0
184	15.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	20558	9500	9500	9500	9500	0	0
185	15.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	12654	9500	9500	9500	0	0
186	15.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	411527	644249	2500000	12654	9500	9500	9500	0	0
187	15.58	April	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	64748	24995	31863	12654	9500	9500	9500	0	0
188	15.67	May	4291940	3835200	1676300	4291940	4291940	4126310	3452140	1423780	4126310	4126310	46594	18977	8208	8987	9500	9500	9500	0	0
189	15.75	June	3473300	2200230	962612	4291940	2897000	2934310	1785680	822846	3924280	2289850	60582	24204	9044	9234	9500	9500	9500	0	0
190	15.83	July	1899900	993295	541278	3278440	2273530	1474090	828057	451673	2577680	1731960	74108	29334	9652	9462	9500	9500	9500	0	0
191	15.92	August	1455160	867953	603639	3757110	2221560	1141880	723055	507142	3062180	1707070	86553	33268	9709	9500	9500	9500	9500	0	0
192	16	September	1633510	1115520	659536	4291940	3444680	1270050	915740	555887	4126310	2812040	87531	33461	9709	9500	9500	9500	9500	0	0
193	16.08	October	2496590	1557710	840659	4291940	4291940	1966500	1255080	721231	4126310	4126310	87633	33461	9709	9500	9500	9500	9500	0	0
194	16.17	November	4291940	4291940	3384430	4291940	4291940	4126310	4126310	2953640	4126310	4126310	62228	28408	9709	9500	9500	9500	9500	0	0
195	16.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	217643	108021	10868	9500	9500	9500	9500	0	0
196	16.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	113614	13338	9500	9500	9500	9500	0	0
197	16.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	12654	9500	9500	9500	0	0
198	16.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	71639	26306	144647	12654	9500	9500	9500	0	0
199	16.58	April	4291940	4291940	4069340	4291940	4291940	4126310	4126310	3857290	4126310	4126310	39240	15602	14383	9956	9500	9500	9500	0	0
200	16.67	May	4291940	2692790	1218550	4291940	4291940	4126310	2258710	1050670	4126310	3968800	41245	20925	8417	9139	9500	9500	9500	0	0
201	16.75	June	3448430	2103630	909347	4291940	3224500	2877520	1693470	782886	4126310	2582760	53228	25863	9234	9367	9500	9500	9500	0	0
202	16.83	July	2153050	1277740	746705	3479980	2464810	1684600	1049770	638235	2800960	1888960	65776	30761	9671	9500	9500	9500	9500	0	0
203	16.92	August	1620960	1041140	582043	3811340	2499930	1271250	860166	487873	3100760	1918420	76628	32593	9690	9500	9500	9500	9500	0	0
204	17	September	1731550	1048740	656495	4291940	3990420	1338000	869254	552862	4126310	3355040	78068	32420	9671	9500	9500	9500	9500	0	0
205	17.08	October	2822950	1686390	882902	4291940	4291940	2234410	1350700	757510	4126310	4126310	79148	32497	9671	9500	9500	9500	9500	0	0
206	17.17	November	4291940	4291940	2876240	4291940	4291940	4126310	3971810	2463950	4126310	4126310	87685	29932	9690	9500	9500	9500	9500	0	0
207	17.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	278534	92708	10336	9500	9500	9500	9500	0	0
208	17.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	277608	250332	21033	9500	9500	9500	9500	0	0
209	17.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	204272	126304	2500000	10963	9500	9500	9500	0	0
210	17.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	2500000	12654	9500	9500	9500	0	0

211	17.58	April	4291940	4291940	3452730	4291940	4291940	4126310	4126310	3224960	4126310	4126310	37131	15622	12027	10754	9500	9500	9500	0	0
212	17.67	May	4291940	3170300	1421480	4291940	4291940	4126310	2702730	1211860	4126310	4126310	51274	21408	8455	9101	9500	9500	9500	0	0
213	17.75	June	3896400	2722180	1451590	4291940	2709800	3359850	2250070	1211440	3734680	2132410	62485	26306	9272	9348	9500	9500	9500	0	0
214	17.83	July	1845050	947581	536035	3469680	2237500	1424380	785181	446047	2760440	1702500	74159	31051	9671	9500	9500	9500	9500	0	0
215	17.92	August	1457900	828457	537308	3704710	2433880	1143430	691992	446039	2976570	1862940	78993	32497	9671	9500	9500	9500	9500	0	0
216	18	September	1658510	1034420	597091	4291940	4078150	1293980	854614	500465	4126310	3483900	79713	32555	9690	9500	9500	9500	9500	0	0
217	18.08	October	3072160	2040080	964134	4291940	4291940	2478910	1623460	817935	4126310	4126310	78531	32458	9671	9500	9500	9500	9500	0	0
218	18.17	November	4291940	4291940	2961330	4291940	4291940	4126310	4126310	2549250	4126310	4126310	77142	31282	9671	9500	9500	9500	9500	0	0
219	18.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	92828	17917	9690	9500	9500	9500	9500	0	0
220	18.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	15599	9500	9500	9500	9500	0	0
221	18.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	1000020	999998	73815	9500	9500	9500	9500	0	0
222	18.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	544468	633468	2500000	9500	9500	9500	9500	0	0
223	18.58	April	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	47005	15699	31426	9500	9500	9500	9500	0	0
224	18.67	May	4291940	3836300	1976820	4291940	4291940	4126310	3435860	1682250	4126310	4126310	46645	19016	8284	9500	9500	9500	9500	0	0
225	18.75	June	3999490	2700250	1289870	4291940	2700510	3470450	2229290	1092780	3907710	2101370	60634	24223	9101	9500	9500	9500	9500	0	0
226	18.83	July	1623850	961228	630161	3443550	2282150	1278550	806991	532878	2720060	1738270	74262	29373	9652	9500	9500	9500	9500	0	0
227	18.92	August	1459070	872388	574453	3805630	2701040	1148760	730934	480189	3078140	2101810	85833	33211	9709	9500	9500	9500	9500	0	0
228	19	September	1838840	1126290	652092	4291940	3935710	1432440	923516	551674	4126310	3331830	87839	33481	9709	9500	9500	9500	9500	0	0
229	19.08	October	2910300	2014210	1061620	4291940	4291940	2339480	1617530	891783	4126310	4126310	88302	33538	9709	9500	9500	9500	9500	0	0
230	19.17	November	4291940	4291940	3006360	4291940	4291940	4126310	4126310	2594770	4126310	4126310	46440	32632	9709	9500	9500	9500	9500	0	0
231	19.25	December	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	148678	36219	9861	9500	9500	9500	9500	0	0
232	19.33	January	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	347499	266629	19171	9500	9500	9500	9500	0	0
233	19.42	February	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	242792	158608	49894	9500	9500	9500	9500	0	0
234	19.5	March	4291940	4291940	4291940	4291940	4291940	4126310	4126310	4126310	4126310	4126310	89588	29604	25802	9500	9500	9500	9500	0	0
235	19.58	April	4291940	4291940	3310300	4291940	4291940	4126310	4126310	3003790	4126310	4126310	39394	15506	8113	9500	9500	9500	9500	0	0
236	19.67	May	4291940	3022000	1235570	4291940	3841290	4126310	2554070	1056140	4126310	3215340	54925	21678	8930	9500	9500	9500	9500	0	0
237	19.75	June	2741460	1576420	756798	4291940	2899290	2195740	1274520	648740	3894600	2316500	67474	26711	9538	9500	9500	9500	9500	0	0
238	19.83	July	2100990	1447830	743609	3462950	2327550	1649460	1163720	630937	2753640	1774990	78582	31417	9690	9500	9500	9500	9500	0	0
239	19.92	August	1504000	890109	577611	3810060	2544330	1177370	743040	480291	3082520	1955470	82131	32806	9690	9500	9500	9500	9500	0	0

(4) Fatigue Cracking

Fatigue Cracking: Project MQP_07_08

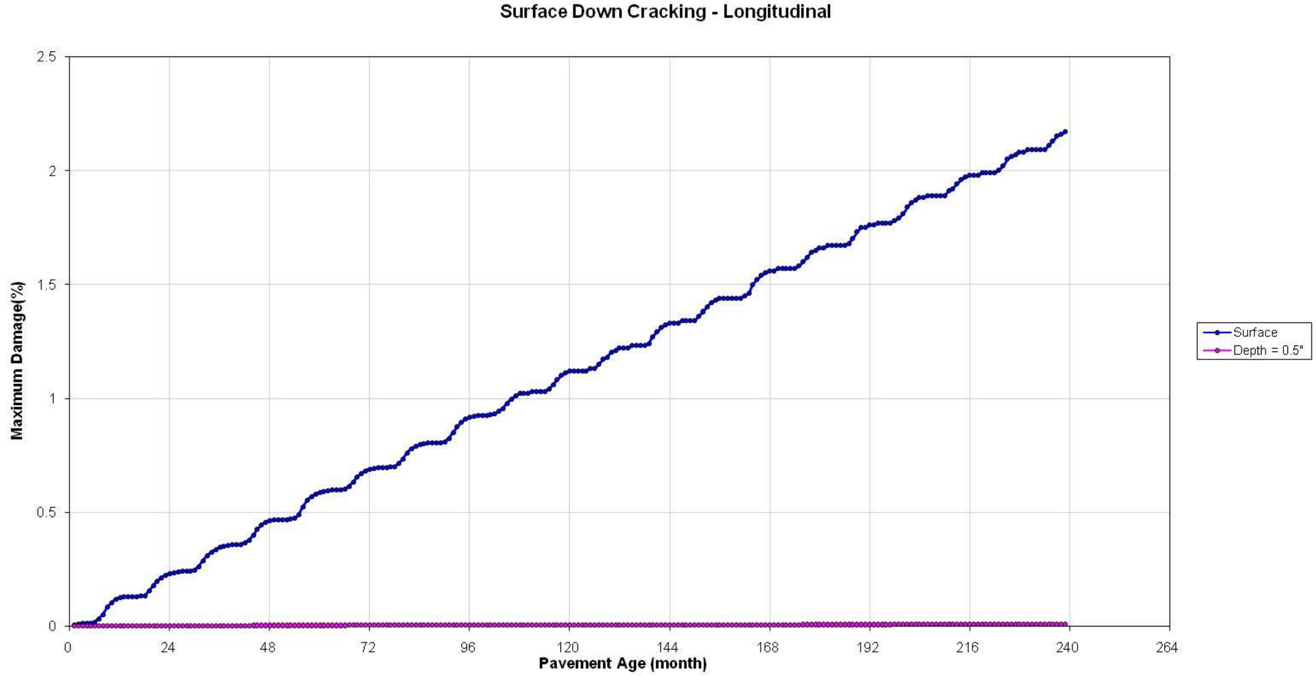
Pavement age			Top Down at Surface			Top Down at 0.5"			Bottom Up at h_{ac}			Reliability	
mo	yr	Month	Maximum Damage (%)	Maximum Cracking (ft/mi)	Location (in)	Maximum Damage (%)	Maximum Cracking (ft/mi)	Location (in)	Maximum Damage (%)	Maximum Cracking (%)	Location (in)	Top Down Cracking (ft/mi)	Bottom Up Cracking (%)
1	0.08	October	0.00455	0	6	0.0000194	0	0	0	0	0	262.76	1.45
2	0.17	November	0.00855	0.01	6	0.0000375	0	2.5	0	0	0	267.86	1.45
3	0.25	December	0.0128	0.01	6	0.0000769	0	2.5	0	0	0	273.1	1.45
4	0.33	January	0.0128	0.01	6	0.0000769	0	2.5	0	0	0	273.1	1.45
5	0.42	February	0.0134	0.01	6	0.0000775	0	2.5	0	0	0	273.82	1.45
6	0.5	March	0.0165	0.02	1.3	0.0000811	0	2.5	0	0	0	277.56	1.45
7	0.58	April	0.0305	0.05	6	0.000132	0	2.5	0	0	0	293.88	1.45
8	0.67	May	0.0497	0.1	6	0.000189	0	2.5	0	0	0	315.29	1.45
9	0.75	June	0.0816	0.21	1.3	0.000242	0	2.5	0	0	0	349.22	1.45
10	0.83	July	0.103	0.31	1.3	0.000297	0	1.3	0	0	0	371.1	1.45
11	0.92	August	0.116	0.36	1.3	0.000341	0	1.3	0	0	0	384.1	1.45
12	1	September	0.123	0.4	1.3	0.000366	0	1.3	0	0	0	391.02	1.45
13	1.08	October	0.127	0.42	1.3	0.000383	0	1.3	0	0	0	394.94	1.45
14	1.17	November	0.129	0.43	1.3	0.000405	0	1.3	0	0	0	396.9	1.45
15	1.25	December	0.13	0.43	1.3	0.000414	0	1.3	0	0	0	397.88	1.45
16	1.33	January	0.13	0.43	1.3	0.000414	0	1.3	0	0	0	397.88	1.45
17	1.42	February	0.132	0.44	1.3	0.000415	0	1.3	0	0	0	399.83	1.45
18	1.5	March	0.134	0.46	1.3	0.000421	0	1.3	0	0	0	401.78	1.45
19	1.58	April	0.153	0.55	1.3	0.000498	0	1.3	0	0	0	420.06	1.45
20	1.67	May	0.178	0.7	1.3	0.000543	0	1.3	0	0	0	443.57	1.45
21	1.75	June	0.195	0.81	1.3	0.00058	0	1.3	0	0	0	459.23	1.45
22	1.83	July	0.211	0.91	1.3	0.000632	0	1.3	0	0	0	473.74	1.45
23	1.92	August	0.224	0.99	1.3	0.00068	0	1.3	0	0	0	485.37	1.45
24	2	September	0.231	1.04	0	0.000704	0	1.3	0	0	0	491.58	1.45
25	2.08	October	0.234	1.06	1.3	0.000722	0	1.3	0	0	0	494.23	1.45

26	2.17	November	0.238	1.08	1.3	0.000746	0	1.3	0	0	0	497.74	1.45
27	2.25	December	0.24	1.1	1.3	0.000764	0	1.3	0	0	0	499.51	1.45
28	2.33	January	0.241	1.11	1.3	0.000764	0	1.3	0	0	0	500.39	1.45
29	2.42	February	0.241	1.11	1.3	0.000764	0	1.3	0	0	0	500.39	1.45
30	2.5	March	0.246	1.14	1.3	0.000778	0	1.3	0	0	0	504.75	1.45
31	2.58	April	0.259	1.24	1.3	0.000849	0	1.3	0	0	0	516.04	1.45
32	2.67	May	0.285	1.43	1.3	0.000895	0	1.3	0	0	0	538.24	1.45
33	2.75	June	0.31	1.62	1.3	0.000944	0	1.3	0	0	0	559.15	1.45
34	2.83	July	0.325	1.75	1.3	0.000998	0	1.3	0	0	0	571.51	1.45
35	2.92	August	0.336	1.84	0	0.00104	0	1.3	0	0	0	580.47	1.45
36	3	September	0.345	1.91	0	0.00107	0	1.3	0	0	0	587.74	1.45
37	3.08	October	0.349	1.94	0	0.00109	0	1.3	0	0	0	590.96	1.45
38	3.17	November	0.354	1.98	1.3	0.00112	0	1.3	0	0	0	594.97	1.45
39	3.25	December	0.356	2	1.3	0.00113	0	1.3	0	0	0	596.57	1.45
40	3.33	January	0.356	2	1.3	0.00113	0	1.3	0	0	0	596.57	1.45
41	3.42	February	0.359	2.03	1.3	0.00114	0	1.3	0	0	0	598.97	1.45
42	3.5	March	0.364	2.08	1.3	0.00115	0	1.3	0	0	0	602.96	1.45
43	3.58	April	0.377	2.18	1.3	0.00123	0	1.3	0	0	0	613.22	1.45
44	3.67	May	0.397	2.37	1.3	0.00127	0	1.3	0	0	0	628.86	1.45
45	3.75	June	0.424	2.62	1.3	0.0013	0	1.3	0	0	0	649.6	1.45
46	3.83	July	0.442	2.78	1.3	0.00134	0	1.3	0	0	0	663.2	1.45
47	3.92	August	0.454	2.9	1.3	0.00137	0	1.3	0	0	0	672.18	1.45
48	4	September	0.462	2.97	1.3	0.0014	0	1.3	0	0	0	678.12	1.45
49	4.08	October	0.465	3.01	1.3	0.00142	0	1.3	0	0	0	680.35	1.45
50	4.17	November	0.468	3.04	1.3	0.00144	0	1.3	0	0	0	682.57	1.45
51	4.25	December	0.468	3.04	1.3	0.00144	0	1.3	0	0	0	682.57	1.45
52	4.33	January	0.468	3.04	1.3	0.00144	0	1.3	0	0	0	682.57	1.45
53	4.42	February	0.469	3.04	1.3	0.00144	0	1.3	0	0	0	683.3	1.45
54	4.5	March	0.472	3.07	1.3	0.00145	0	1.3	0	0	0	685.51	1.45
55	4.58	April	0.487	3.23	1.3	0.00149	0	1.3	0	0	0	696.5	1.45
56	4.67	May	0.523	3.6	1.3	0.00155	0	1.3	0	0	0	722.42	1.45
57	4.75	June	0.551	3.89	1.3	0.0016	0	1.3	0	0	0	742.16	1.45
58	4.83	July	0.568	4.08	0	0.00164	0	1.3	0	0	0	753.98	1.45
59	4.92	August	0.58	4.21	0	0.00169	0	1.3	0	0	0	762.24	1.45
60	5	September	0.588	4.29	0	0.00172	0	1.3	0	0	0	767.7	1.45
61	5.08	October	0.591	4.33	0	0.00174	0	1.3	0	0	0	769.76	1.45
62	5.17	November	0.594	4.36	0	0.00176	0	1.3	0	0	0	771.79	1.45
63	5.25	December	0.596	4.38	0	0.00178	0	1.3	0	0	0	773.15	1.45
64	5.33	January	0.596	4.38	0	0.00178	0	1.3	0	0	0	773.15	1.45
65	5.42	February	0.598	4.4	0	0.00179	0	1.3	0	0	0	774.51	1.45
66	5.5	March	0.6	4.43	0	0.00179	0	1.3	0	0	0	775.87	1.45
67	5.58	April	0.612	4.57	1.3	0.00186	0	1.3	0	0	0	783.97	1.45
68	5.67	May	0.632	4.79	1.3	0.00191	0	1.3	0	0	0	797.33	1.45
69	5.75	June	0.654	5.04	0	0.00195	0	1.3	0	0	0	811.84	1.45
70	5.83	July	0.669	5.22	0	0.00199	0	1.3	0	0	0	821.63	1.45
71	5.92	August	0.681	5.37	0	0.00204	0	1.3	0	0	0	829.4	1.45
72	6	September	0.689	5.47	0	0.00207	0	1.3	0	0	0	834.55	1.45
73	6.08	October	0.693	5.51	0	0.00209	0	1.3	0	0	0	837.11	1.45
74	6.17	November	0.696	5.55	0	0.00211	0	1.3	0	0	0	839.03	1.45
75	6.25	December	0.696	5.55	0	0.00212	0	1.3	0	0	0	839.03	1.45
76	6.33	January	0.696	5.55	0	0.00212	0	1.3	0	0	0	839.03	1.45
77	6.42	February	0.697	5.56	0	0.00212	0	1.3	0	0	0	839.67	1.45
78	6.5	March	0.7	5.6	1.3	0.00213	0	1.3	0	0	0	841.58	1.45
79	6.58	April	0.712	5.74	1.3	0.00218	0	1.3	0	0	0	849.2	1.45
80	6.67	May	0.733	6	1.3	0.00223	0	1.3	0	0	0	862.42	1.45
81	6.75	June	0.76	6.34	1.3	0.00229	0	1.3	0	0	0	879.18	1.45
82	6.83	July	0.778	6.57	0	0.00233	0	1.3	0	0	0	890.21	1.45
83	6.92	August	0.788	6.7	0	0.00237	0	1.3	0	0	0	896.29	1.45
84	7	September	0.796	6.8	0	0.0024	0	1.3	0	0	0	901.13	1.45
85	7.08	October	0.799	6.84	0	0.00242	0	1.3	0	0	0	902.94	1.45
86	7.17	November	0.803	6.89	0	0.00245	0	1.3	0	0	0	905.34	1.45
87	7.25	December	0.804	6.9	0	0.00246	0	1.3	0	0	0	905.94	1.45
88	7.33	January	0.804	6.9	0	0.00246	0	1.3	0	0	0	905.94	1.45
89	7.42	February	0.804	6.91	0	0.00246	0	1.3	0	0	0	905.95	1.45
90	7.5	March	0.809	6.97	0	0.00247	0	1.3	0	0	0	908.95	1.45
91	7.58	April	0.824	7.18	1.3	0.00253	0	1.3	0	0	0	917.91	1.45
92	7.67	May	0.85	7.51	1.3	0.00257	0	1.3	0	0	0	933.23	1.45
93	7.75	June	0.874	7.85	1.3	0.0026	0	1.3	0	0	0	947.21	1.45
94	7.83	July	0.894	8.12	0	0.00264	0	1.3	0	0	0	958.71	1.45
95	7.92	August	0.908	8.31	0	0.00268	0	1.3	0	0	0	966.69	1.45
96	8	September	0.916	8.43	0	0.00271	0	1.3	0	0	0	971.23	1.45
97	8.08	October	0.92	8.48	0	0.00273	0	1.3	0	0	0	973.48	1.45
98	8.17	November	0.924	8.54	0	0.00276	0	1.3	0	0	0	975.74	1.45
99	8.25	December	0.924	8.54	0	0.00276	0	1.3	0	0	0	975.74	1.45
100	8.33	January	0.924	8.54	0	0.00276	0	1.3	0	0	0	975.74	1.45

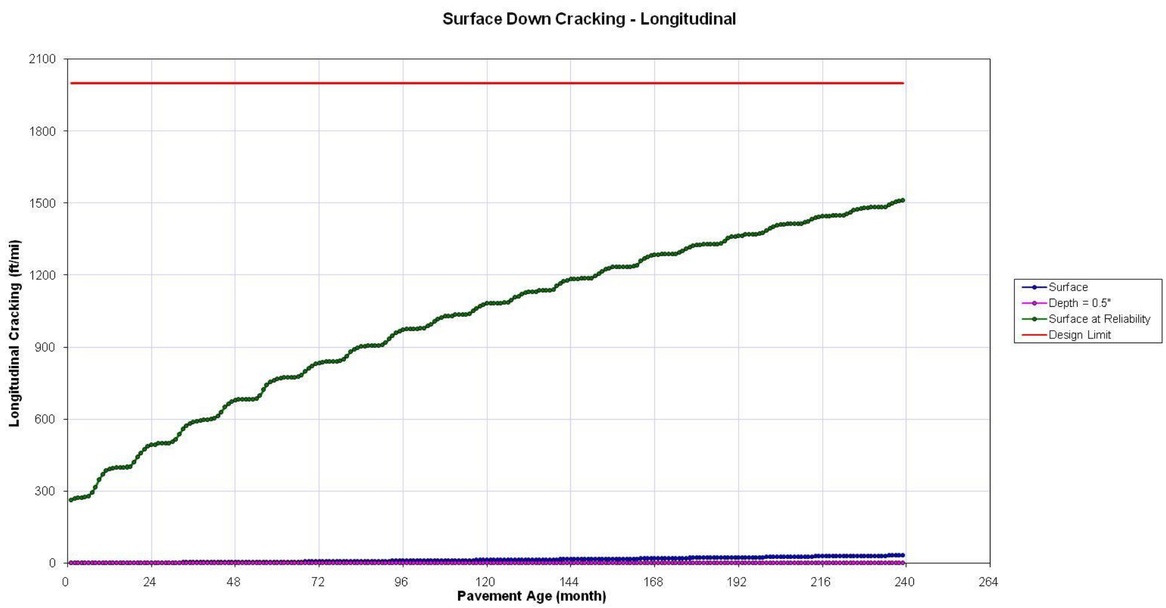
101	8.42	February	0.926	8.57	0	0.00276	0	1.3	0	0	0	976.87	1.45
102	8.5	March	0.93	8.62	0	0.00277	0	1.3	0	0	0	979.11	1.45
103	8.58	April	0.943	8.8	1.3	0.00283	0	1.3	0	0	0	986.38	1.45
104	8.67	May	0.954	8.96	1.3	0.00287	0	1.3	0	0	0	992.49	1.45
105	8.75	June	0.978	9.31	1.3	0.00292	0	1.3	0	0	0	1005.72	1.45
106	8.83	July	0.996	9.56	0	0.00297	0	1.3	0	0	0	1015.51	1.45
107	8.92	August	1.01	9.75	0	0.00301	0	1.3	0	0	0	1023.06	1.45
108	9	September	1.02	9.86	0	0.00304	0	1.3	0	0	0	1028.4	1.45
109	9.08	October	1.02	9.9	0	0.00306	0	1.3	0	0	0	1028.44	1.45
110	9.17	November	1.02	9.94	0	0.00308	0	1.3	0	0	0	1028.48	1.45
111	9.25	December	1.03	10	0	0.00312	0	1.3	0	0	0	1033.73	1.45
112	9.33	January	1.03	10	0	0.00312	0	1.3	0	0	0	1033.73	1.45
113	9.42	February	1.03	10	0	0.00312	0	1.3	0	0	0	1033.73	1.45
114	9.5	March	1.03	10.1	0	0.00313	0	1.3	0	0	0	1033.83	1.45
115	9.58	April	1.04	10.2	0	0.00318	0	1.3	0	0	0	1039.1	1.45
116	9.67	May	1.06	10.5	0	0.00324	0	1.3	0	0	0	1049.65	1.45
117	9.75	June	1.08	10.9	0	0.00329	0	1.3	0	0	0	1060.2	1.45
118	9.83	July	1.1	11.1	1.3	0.00334	0	1.3	0	0	0	1070.44	1.45
119	9.92	August	1.11	11.3	0	0.00338	0	1.3	0	0	0	1075.62	1.45
120	10	September	1.12	11.4	0	0.0034	0	1.3	0	0	0	1080.68	1.45
121	10.1	October	1.12	11.4	0	0.00342	0	1.3	0	0	0	1080.68	1.45
122	10.2	November	1.12	11.5	0	0.00344	0	1.3	0	0	0	1080.78	1.45
123	10.3	December	1.12	11.5	0	0.00345	0	1.3	0	0	0	1080.78	1.45
124	10.3	January	1.12	11.5	0	0.00345	0	1.3	0	0	0	1080.78	1.45
125	10.4	February	1.13	11.5	1.3	0.00345	0	1.3	0	0	0	1085.71	1.45
126	10.5	March	1.13	11.6	0	0.00346	0	1.3	0	0	0	1085.81	1.45
127	10.6	April	1.15	11.8	1.3	0.00354	0	1.3	0	0	0	1095.8	1.45
128	10.7	May	1.17	12.2	0	0.00358	0	1.3	0	0	0	1105.88	1.45
129	10.8	June	1.18	12.4	1.3	0.00362	0	1.3	0	0	0	1110.89	1.45
130	10.8	July	1.2	12.7	0	0.00366	0	1.3	0	0	0	1120.73	1.45
131	10.9	August	1.21	12.9	0	0.00371	0	1.3	0	0	0	1125.66	1.45
132	11	September	1.22	13	0	0.00373	0	1.3	0	0	0	1130.47	1.45
133	11.1	October	1.22	13	1.3	0.00375	0	1.3	0	0	0	1130.47	1.45
134	11.2	November	1.22	13.1	0	0.00377	0	1.3	0	0	0	1130.57	1.45
135	11.3	December	1.23	13.1	0	0.00379	0	1.3	0	0	0	1135.26	1.45
136	11.3	January	1.23	13.1	0	0.00379	0	1.3	0	0	0	1135.26	1.45
137	11.4	February	1.23	13.1	0	0.00379	0	1.3	0	0	0	1135.26	1.45
138	11.5	March	1.23	13.2	1.3	0.00381	0	1.3	0	0	0	1135.36	1.45
139	11.6	April	1.24	13.4	0	0.00388	0	1.3	0	0	0	1140.22	1.45
140	11.7	May	1.27	13.8	0	0.00392	0	1.3	0	0	0	1154.47	1.45
141	11.8	June	1.29	14.2	1.3	0.00397	0	1.3	0	0	0	1163.99	1.45
142	11.8	July	1.31	14.4	0	0.00402	0	1.3	0	0	0	1173.23	1.45
143	11.9	August	1.32	14.6	0	0.00406	0	1.3	0	0	0	1177.91	1.45
144	12	September	1.33	14.7	0	0.00409	0	1.3	0	0	0	1182.47	1.45
145	12.1	October	1.33	14.8	0	0.00411	0	1.3	0	0	0	1182.57	1.45
146	12.2	November	1.33	14.9	0	0.00414	0	1.3	0	0	0	1182.67	1.45
147	12.3	December	1.34	14.9	0	0.00415	0	1.3	0	0	0	1187.12	1.45
148	12.3	January	1.34	14.9	0	0.00415	0	1.3	0	0	0	1187.12	1.45
149	12.4	February	1.34	15	0	0.00416	0	1.3	0	0	0	1187.22	1.45
150	12.5	March	1.34	15.1	1.3	0.00417	0	1.3	0	0	0	1187.32	1.45
151	12.6	April	1.36	15.3	1.3	0.00425	0	1.3	0	0	0	1196.33	1.45
152	12.7	May	1.38	15.6	1.3	0.00429	0	1.3	0	0	0	1205.37	1.45
153	12.8	June	1.4	16.1	1.3	0.00433	0	1.3	0	0	0	1214.52	1.45
154	12.8	July	1.42	16.3	1.3	0.00436	0	1.3	0	0	0	1223.29	1.45
155	12.9	August	1.43	16.5	0	0.00439	0	1.3	0	0	0	1227.75	1.45
156	13	September	1.44	16.7	0	0.00442	0	1.3	0	0	0	1232.18	1.45
157	13.1	October	1.44	16.7	0	0.00444	0	1.3	0	0	0	1232.18	1.45
158	13.2	November	1.44	16.8	0	0.00446	0	1.3	0	0	0	1232.28	1.45
159	13.3	December	1.44	16.8	0	0.00446	0	1.3	0	0	0	1232.28	1.45
160	13.3	January	1.44	16.8	0	0.00446	0	1.3	0	0	0	1232.28	1.45
161	13.4	February	1.44	16.8	0	0.00446	0	1.3	0	0	0	1232.28	1.45
162	13.5	March	1.45	16.9	1.3	0.00447	0	1.3	0	0	0	1236.6	1.45
163	13.6	April	1.46	17.1	0	0.00451	0	1.3	0	0	0	1240.99	1.45
164	13.7	May	1.5	17.7	0	0.00457	0	1.3	0	0	0	1258.18	1.45
165	13.8	June	1.52	18.2	0	0.00462	0	1.3	0	0	0	1266.87	1.45
166	13.8	July	1.54	18.5	0	0.00466	0	1.3	0	0	0	1275.27	1.45
167	13.9	August	1.55	18.7	0	0.00471	0	1.3	0	0	0	1279.5	1.45
168	14	September	1.56	18.9	0	0.00473	0	1.3	0	0	0	1283.71	1.45
169	14.1	October	1.56	18.9	0	0.00475	0	1.3	0	0	0	1283.71	1.45
170	14.2	November	1.57	19	0	0.00477	0	1.3	0	0	0	1287.8	1.45
171	14.3	December	1.57	19	0	0.0048	0	1.3	0	0	0	1287.8	1.45
172	14.3	January	1.57	19	0	0.0048	0	1.3	0	0	0	1287.8	1.45
173	14.4	February	1.57	19.1	1.3	0.0048	0	1.3	0	0	0	1287.9	1.45
174	14.5	March	1.57	19.1	0	0.00481	0	1.3	0	0	0	1287.9	1.45
175	14.6	April	1.58	19.3	1.3	0.00488	0	1.3	0	0	0	1292.07	1.45

176	14.7	May	1.6	19.7	0	0.00492	0	1.3	0	0	0	1300.36	1.45
177	14.8	June	1.62	20.1	0	0.00496	0	1.3	0	0	0	1308.58	1.45
178	14.8	July	1.64	20.3	0	0.005	0	1.3	0	0	0	1316.54	1.45
179	14.9	August	1.65	20.6	0	0.00505	0	1.3	0	0	0	1320.69	1.45
180	15	September	1.66	20.7	0	0.00508	0	1.3	0	0	0	1324.62	1.45
181	15.1	October	1.66	20.8	0	0.0051	0	1.3	0	0	0	1324.72	1.45
182	15.2	November	1.67	20.9	0	0.00513	0	1.3	0	0	0	1328.64	1.45
183	15.3	December	1.67	20.9	0	0.00513	0	1.3	0	0	0	1328.64	1.45
184	15.3	January	1.67	20.9	0	0.00513	0	1.3	0	0	0	1328.64	1.45
185	15.4	February	1.67	20.9	0	0.00513	0	1.3	0	0	0	1328.64	1.45
186	15.5	March	1.67	20.9	1.3	0.00513	0	1.3	0	0	0	1328.64	1.45
187	15.6	April	1.68	21.1	0	0.00519	0	1.3	0	0	0	1332.64	1.45
188	15.7	May	1.7	21.5	1.3	0.00524	0	1.3	0	0	0	1340.59	1.45
189	15.8	June	1.73	22	0	0.0053	0	1.3	0	0	0	1352.29	1.45
190	15.8	July	1.75	22.4	0	0.00534	0	1.3	0	0	0	1360.08	1.45
191	15.9	August	1.75	22.6	0	0.00538	0	1.3	0	0	0	1360.28	1.45
192	16	September	1.76	22.7	0	0.00541	0	1.3	0	0	0	1364.05	1.45
193	16.1	October	1.76	22.8	0	0.00543	0	1.3	0	0	0	1364.15	1.45
194	16.2	November	1.77	22.9	0	0.00546	0	1.3	0	0	0	1367.91	1.45
195	16.3	December	1.77	22.9	0	0.00547	0	1.3	0	0	0	1367.91	1.45
196	16.3	January	1.77	22.9	0	0.00547	0	1.3	0	0	0	1367.91	1.45
197	16.4	February	1.77	22.9	0	0.00547	0	1.3	0	0	0	1367.91	1.45
198	16.5	March	1.78	23	1.3	0.00548	0	1.3	0	0	0	1371.65	1.45
199	16.6	April	1.79	23.3	1.3	0.00553	0	1.3	0	0	0	1375.57	1.45
200	16.7	May	1.81	23.8	0	0.00558	0	1.3	0	0	0	1383.28	1.45
201	16.8	June	1.84	24.3	0	0.00561	0	1.3	0	0	0	1394.47	1.45
202	16.8	July	1.86	24.7	0	0.00565	0	1.3	0	0	0	1401.92	1.45
203	16.9	August	1.87	24.9	0	0.00569	0	1.3	0	0	0	1405.63	1.45
204	17	September	1.88	25.1	0	0.00572	0	1.3	0	0	0	1409.32	1.45
205	17.1	October	1.88	25.2	0	0.00574	0	1.3	0	0	0	1409.42	1.45
206	17.2	November	1.89	25.2	0	0.00577	0	1.3	0	0	0	1412.89	1.45
207	17.3	December	1.89	25.3	0	0.00577	0	1.3	0	0	0	1412.99	1.45
208	17.3	January	1.89	25.3	0	0.00577	0	1.3	0	0	0	1412.99	1.45
209	17.4	February	1.89	25.3	0	0.00577	0	1.3	0	0	0	1412.99	1.45
210	17.5	March	1.89	25.4	0	0.00578	0	1.3	0	0	0	1413.09	1.45
211	17.6	April	1.91	25.6	0	0.00584	0	1.3	0	0	0	1420.2	1.45
212	17.7	May	1.92	25.9	1.3	0.00588	0	1.3	0	0	0	1423.93	1.45
213	17.8	June	1.94	26.3	1.3	0.00593	0	1.3	0	0	0	1431.16	1.45
214	17.8	July	1.96	26.7	0	0.00598	0	1.3	0	0	0	1438.33	1.45
215	17.9	August	1.97	27	1.3	0.00602	0	1.3	0	0	0	1441.99	1.45
216	18	September	1.98	27.1	0	0.00605	0	1.3	0	0	0	1445.44	1.45
217	18.1	October	1.98	27.2	0	0.00606	0	1.3	0	0	0	1445.54	1.45
218	18.2	November	1.98	27.2	1.3	0.00608	0	1.3	0	0	0	1445.54	1.45
219	18.3	December	1.99	27.3	0	0.00613	0	1.3	0	0	0	1448.98	1.45
220	18.3	January	1.99	27.3	0	0.00613	0	1.3	0	0	0	1448.98	1.45
221	18.4	February	1.99	27.3	0	0.00613	0	1.3	0	0	0	1448.98	1.45
222	18.5	March	1.99	27.4	0	0.00613	0	1.3	0	0	0	1449.08	1.45
223	18.6	April	2	27.6	0	0.00619	0	1.3	0	0	0	1452.6	1.45
224	18.7	May	2.02	28	1.3	0.00625	0	1.3	0	0	0	1459.6	1.45
225	18.8	June	2.05	28.5	0	0.0063	0	1.3	0	0	0	1469.91	1.45
226	18.8	July	2.06	28.9	1.3	0.00634	0	1.3	0	0	0	1473.56	1.45
227	18.9	August	2.07	29.1	0	0.00638	0	1.3	0	0	0	1476.99	1.45
228	19	September	2.08	29.2	0	0.00641	0	1.3	0	0	0	1480.31	1.45
229	19.1	October	2.08	29.3	0	0.00642	0	1.3	0	0	0	1480.41	1.45
230	19.2	November	2.09	29.3	1.3	0.00645	0	1.3	0	0	0	1483.61	1.45
231	19.3	December	2.09	29.3	0	0.00645	0	1.3	0	0	0	1483.61	1.45
232	19.3	January	2.09	29.3	0	0.00645	0	1.3	0	0	0	1483.61	1.45
233	19.4	February	2.09	29.4	0	0.00646	0	1.3	0	0	0	1483.71	1.45
234	19.5	March	2.09	29.4	1.3	0.00646	0	1.3	0	0	0	1483.71	1.45
235	19.6	April	2.11	29.8	0	0.00654	0	1.3	0	0	0	1490.49	1.45
236	19.7	May	2.13	30.3	1.3	0.00659	0	1.3	0	0	0	1497.31	1.45
237	19.8	June	2.15	30.6	1.3	0.00662	0	1.3	0	0	0	1503.89	1.45
238	19.8	July	2.16	30.9	0	0.00667	0	1.3	0	0	0	1507.31	1.45
239	19.9	August	2.17	31.2	1.3	0.00671	0	1.3	0	0	0	1510.71	1.45
240	20	September	2.18	31.3	0	0.00674	0	1.3	0	0	0	1513.91	1.45

Surface Down Cracking in the Longitudinal Direction – Maximum Damage %



Surface Down Cracking in the Longitudinal Direction – Maximum Damage %



(5) Thermal Cracking

Thermal Cracking: Project MQP_07_08

Pavement age			Crack Depth C_{ave}	Depth Ratio		Average	Crack Length
mo	yr	Month	(in)	C/h_{ac}	Crack Length (ft/mi)	Crack Spacing (ft)	at Reliability (ft/mi)
1	0.08	October	0	0	0		84.3
2	0.17	November	0	0	0		84.3
3	0.25	December	0	0	0		84.3
4	0.33	January	0	0	0		84.3
5	0.42	February	0	0	0		84.3
6	0.5	March	0	0	0		84.3
7	0.58	April	0	0	0		84.3
8	0.67	May	0	0	0		84.3
9	0.75	June	0	0	0		84.3
10	0.83	July	0	0	0		84.3
11	0.92	August	0	0	0		84.3
12	1	September	0	0	0		84.3
13	1.08	October	0	0	0		84.3
14	1.17	November	0	0	0		84.3
15	1.25	December	0	0	0		84.3
16	1.33	January	0	0	0		84.3
17	1.42	February	0	0	0		84.3
18	1.5	March	0	0	0		84.3
19	1.58	April	0	0	0		84.3
20	1.67	May	0	0	0		84.3
21	1.75	June	0	0	0		84.3
22	1.83	July	0	0	0		84.3
23	1.92	August	0	0	0		84.3
24	2	September	0	0	0		84.3
25	2.08	October	0	0	0		84.3
26	2.17	November	0	0	0		84.3
27	2.25	December	0	0	0		84.3
28	2.33	January	0	0	0		84.3
29	2.42	February	0	0	0		84.3
30	2.5	March	0	0	0		84.3
31	2.58	April	0	0	0		84.3
32	2.67	May	0	0	0		84.3
33	2.75	June	0	0	0		84.3
34	2.83	July	0	0	0		84.3
35	2.92	August	0	0	0		84.3
36	3	September	0	0	0		84.3
37	3.08	October	0	0	0		84.3
38	3.17	November	0	0	0		84.3
39	3.25	December	0	0	0		84.3
40	3.33	January	0	0	0		84.3
41	3.42	February	0	0	0		84.3
42	3.5	March	0	0	0		84.3
43	3.58	April	0	0	0		84.3
44	3.67	May	0	0	0		84.3
45	3.75	June	0	0	0		84.3
46	3.83	July	0	0	0		84.3
47	3.92	August	0	0	0		84.3
48	4	September	0	0	0		84.3
49	4.08	October	0	0	0		84.3
50	4.17	November	0	0	0		84.3

51	4.25	December	0	0	0		84.3
52	4.33	January	0	0	0		84.3
53	4.42	February	0	0	0		84.3
54	4.5	March	0	0	0		84.3
55	4.58	April	0	0	0		84.3
56	4.67	May	0	0	0		84.3
57	4.75	June	0	0	0		84.3
58	4.83	July	0	0	0		84.3
59	4.92	August	0	0	0		84.3
60	5	September	0	0	0		84.3
61	5.08	October	0	0	0		84.3
62	5.17	November	0	0	0		84.3
63	5.25	December	0	0	0		84.3
64	5.33	January	0	0	0		84.3
65	5.42	February	0	0	0		84.3
66	5.5	March	0	0	0		84.3
67	5.58	April	0	0	0		84.3
68	5.67	May	0	0	0		84.3
69	5.75	June	0	0	0		84.3
70	5.83	July	0	0	0		84.3
71	5.92	August	0	0	0		84.3
72	6	September	0	0	0		84.3
73	6.08	October	0	0	0		84.3
74	6.17	November	0	0	0		84.3
75	6.25	December	0	0	0		84.3
76	6.33	January	0	0	0		84.3
77	6.42	February	0	0	0		84.3
78	6.5	March	0	0	0		84.3
79	6.58	April	0	0	0		84.3
80	6.67	May	0	0	0		84.3
81	6.75	June	0	0	0		84.3
82	6.83	July	0	0	0		84.3
83	6.92	August	0	0	0		84.3
84	7	September	0	0	0		84.3
85	7.08	October	0	0	0		84.3
86	7.17	November	0	0	0		84.3
87	7.25	December	0	0	0		84.3
88	7.33	January	0	0	0		84.3
89	7.42	February	0	0	0		84.3
90	7.5	March	0	0	0		84.3
91	7.58	April	0	0	0		84.3
92	7.67	May	0	0	0		84.3
93	7.75	June	0	0	0		84.3
94	7.83	July	0	0	0		84.3
95	7.92	August	0	0	0		84.3
96	8	September	0	0	0		84.3
97	8.08	October	0	0	0		84.3
98	8.17	November	0	0	0		84.3
99	8.25	December	0	0	0		84.3
100	8.33	January	0	0	0		84.3
101	8.42	February	0	0	0		84.3
102	8.5	March	0	0	0		84.3
103	8.58	April	0	0	0		84.3
104	8.67	May	0	0	0		84.3
105	8.75	June	0	0	0		84.3

106	8.83	July	0	0	0		84.3
107	8.92	August	0	0	0		84.3
108	9	September	0	0	0		84.3
109	9.08	October	0	0	0		84.3
110	9.17	November	0	0	0		84.3
111	9.25	December	0	0	0		84.3
112	9.33	January	0	0	0		84.3
113	9.42	February	0	0	0		84.3
114	9.5	March	0	0	0		84.3
115	9.58	April	0	0	0		84.3
116	9.67	May	0	0	0		84.3
117	9.75	June	0	0	0		84.3
118	9.83	July	0	0	0		84.3
119	9.92	August	0	0	0		84.3
120	10	September	0	0	0		84.3
121	10.1	October	0	0	0		84.3
122	10.2	November	0	0	0		84.3
123	10.3	December	0	0	0		84.3
124	10.3	January	0	0	0		84.3
125	10.4	February	0	0	0		84.3
126	10.5	March	0	0	0		84.3
127	10.6	April	0	0	0		84.3
128	10.7	May	0	0	0		84.3
129	10.8	June	0	0	0		84.3
130	10.8	July	0	0	0		84.3
131	10.9	August	0	0	0		84.3
132	11	September	0	0	0		84.3
133	11.1	October	0	0	0		84.3
134	11.2	November	0	0	0		84.3
135	11.3	December	0	0	0		84.3
136	11.3	January	0	0	0		84.3
137	11.4	February	0	0	0		84.3
138	11.5	March	0	0	0		84.3
139	11.6	April	0	0	0		84.3
140	11.7	May	0	0	0		84.3
141	11.8	June	0	0	0		84.3
142	11.8	July	0	0	0		84.3
143	11.9	August	0	0	0		84.3
144	12	September	0	0	0		84.3
145	12.1	October	0	0	0		84.3
146	12.2	November	0	0	0		84.3
147	12.3	December	0	0	0		84.3
148	12.3	January	0	0	0		84.3
149	12.4	February	0	0	0		84.3
150	12.5	March	0	0	0		84.3
151	12.6	April	0	0	0		84.3
152	12.7	May	0	0	0		84.3
153	12.8	June	0	0	0		84.3
154	12.8	July	0	0	0		84.3
155	12.9	August	0	0	0		84.3
156	13	September	0	0	0		84.3
157	13.1	October	0	0	0		84.3
158	13.2	November	0	0	0		84.3
159	13.3	December	0	0	0		84.3
160	13.3	January	0	0	0		84.3

161	13.4	February	0	0	0		84.3
162	13.5	March	0	0	0		84.3
163	13.6	April	0	0	0		84.3
164	13.7	May	0	0	0		84.3
165	13.8	June	0	0	0		84.3
166	13.8	July	0	0	0		84.3
167	13.9	August	0	0	0		84.3
168	14	September	0	0	0		84.3
169	14.1	October	0	0	0		84.3
170	14.2	November	0	0	0		84.3
171	14.3	December	0	0	0		84.3
172	14.3	January	0	0	0		84.3
173	14.4	February	0	0	0		84.3
174	14.5	March	0	0	0		84.3
175	14.6	April	0	0	0		84.3
176	14.7	May	0	0	0		84.3
177	14.8	June	0	0	0		84.3
178	14.8	July	0	0	0		84.3
179	14.9	August	0	0	0		84.3
180	15	September	0	0	0		84.3
181	15.1	October	0	0	0		84.3
182	15.2	November	0	0	0		84.3
183	15.3	December	0	0	0		84.3
184	15.3	January	0	0	0		84.3
185	15.4	February	0	0	0		84.3
186	15.5	March	0	0	0		84.3
187	15.6	April	0	0	0		84.3
188	15.7	May	0	0	0		84.3
189	15.8	June	0	0	0		84.3
190	15.8	July	0	0	0		84.3
191	15.9	August	0	0	0		84.3
192	16	September	0	0	0		84.3
193	16.1	October	0	0	0		84.3
194	16.2	November	0	0	0		84.3
195	16.3	December	0	0	0		84.3
196	16.3	January	0	0	0		84.3
197	16.4	February	0	0	0		84.3
198	16.5	March	0	0	0		84.3
199	16.6	April	0	0	0		84.3
200	16.7	May	0	0	0		84.3
201	16.8	June	0	0	0		84.3
202	16.8	July	0	0	0		84.3
203	16.9	August	0	0	0		84.3
204	17	September	0	0	0		84.3
205	17.1	October	0	0	0		84.3
206	17.2	November	0	0	0		84.3
207	17.3	December	0	0	0		84.3
208	17.3	January	0	0	0		84.3
209	17.4	February	0	0	0		84.3
210	17.5	March	0	0	0		84.3
211	17.6	April	0	0	0		84.3
212	17.7	May	0	0	0		84.3
213	17.8	June	0	0	0		84.3
214	17.8	July	0	0	0		84.3
215	17.9	August	0	0	0		84.3

216	18	September	0	0	0		84.3
217	18.1	October	0	0	0		84.3
218	18.2	November	0	0	0		84.3
219	18.3	December	0	0	0		84.3
220	18.3	January	0	0	0		84.3
221	18.4	February	0	0	0		84.3
222	18.5	March	0	0	0		84.3
223	18.6	April	0	0	0		84.3
224	18.7	May	0	0	0		84.3
225	18.8	June	0	0	0		84.3
226	18.8	July	0	0	0		84.3
227	18.9	August	0	0	0		84.3
228	19	September	0	0	0		84.3
229	19.1	October	0	0	0		84.3
230	19.2	November	0	0	0		84.3
231	19.3	December	0	0	0		84.3
232	19.3	January	0	0	0		84.3
233	19.4	February	0	0	0		84.3
234	19.5	March	0	0	0		84.3
235	19.6	April	0	0	0		84.3
236	19.7	May	0	0	0		84.3
237	19.8	June	0	0	0		84.3
238	19.8	July	0	0	0		84.3
239	19.9	August	0	0	0		84.3
240	20	September	0	0	0		84.3

(6) Total Rutting

Predicted Rutting: Project MQP_07_08

Pavement age		Month	Maximum Rutting (inch)											
mo	yr		AC1	Location (in)	GB2	Location (in)	GB3	Location (in)	SubTotalAC	SubTotalBase	SubTotalSG	Total	Location (in)	TotalRutReliability
1	0.08	October	1	0	2	0	3	0	1	5	0	4	0	4.6384
2	0.17	November	0.0025	0	0.0134	0	0.0769	0	0.0025	0.0903	0	0.1172	0	0.1582
3	0.25	December	0.0029	0	0.0176	0	0.0872	0	0.0029	0.1049	0	0.1376	0	0.1825
4	0.33	January	0.003	0	0.0181	0	0.1075	0	0.003	0.1256	0	0.1515	0	0.2015
5	0.42	February	0.003	0	0.0181	0	0.1075	0	0.003	0.1256	0	0.1528	0	0.2028
6	0.5	March	0.0031	0	0.0181	0	0.1075	0	0.0031	0.1256	0	0.1529	0	0.2029
7	0.58	April	0.0031	0	0.0182	0	0.1087	0	0.0031	0.1269	0	0.153	0	0.2033
8	0.67	May	0.0046	0	0.0225	0	0.1494	0	0.0046	0.1719	0	0.1672	0	0.2279
9	0.75	June	0.007	0	0.0251	0	0.1579	0	0.007	0.183	0	0.1822	0	0.2454
10	0.83	July	0.0113	0	0.0271	0	0.1614	0	0.0113	0.1885	0	0.1912	0	0.2556
11	0.92	August	0.0142	0	0.0278	0	0.1623	0	0.0142	0.1901	0	0.1964	0	0.2611
12	1	September	0.0156	0	0.028	0	0.1627	0	0.0156	0.1907	0	0.2005	0	0.2653
13	1.08	October	0.0161	0	0.0281	0	0.1629	0	0.0161	0.191	0	0.2037	0	0.2686
14	1.17	November	0.0163	0	0.0282	0	0.163	0	0.0163	0.1912	0	0.2066	0	0.2715
15	1.25	December	0.0163	0	0.0284	0	0.163	0	0.0163	0.1914	0	0.209	0	0.274
16	1.33	January	0.0163	0	0.0284	0	0.1631	0	0.0163	0.1915	0	0.2102	0	0.2752
17	1.42	February	0.0163	0	0.0284	0	0.1631	0	0.0163	0.1915	0	0.2105	0	0.2755
18	1.5	March	0.0163	0	0.0284	0	0.1631	0	0.0163	0.1915	0	0.2108	0	0.2758
19	1.58	April	0.0163	0	0.0284	0	0.1633	0	0.0163	0.1917	0	0.2117	0	0.2767
20	1.67	May	0.017	0	0.0294	0	0.1715	0	0.017	0.2009	0	0.2181	0	0.2851
21	1.75	June	0.0184	0	0.0303	0	0.1743	0	0.0184	0.2046	0	0.2229	0	0.2909
22	1.83	July	0.0195	0	0.0306	0	0.1751	0	0.0195	0.2057	0	0.2257	0	0.294
23	1.92	August	0.021	0	0.0308	0	0.1753	0	0.021	0.2061	0	0.2279	0	0.2965
24	2	September	0.0221	0	0.031	0	0.1755	0	0.0221	0.2065	0	0.23	0	0.2988
25	2.08	October	0.0225	0	0.031	0	0.1756	0	0.0225	0.2066	0	0.2318	0	0.3006

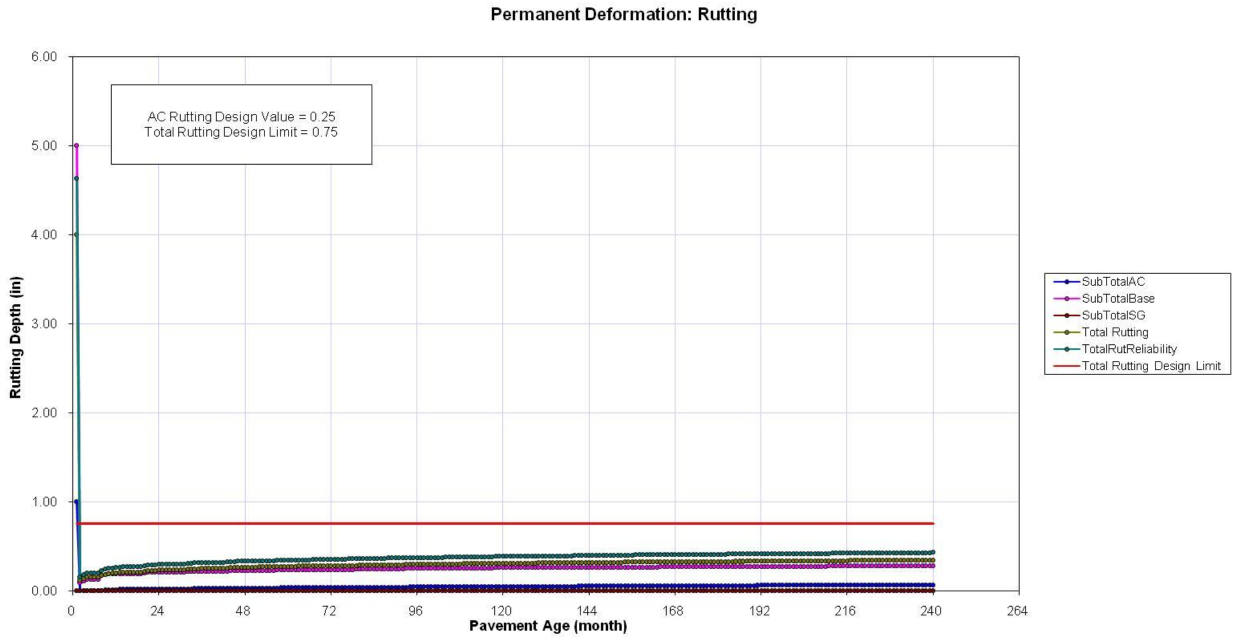
26	2.17	November	0.0226	0	0.031	0	0.1757	0	0.0226	0.2067	0	0.2333	0	0.3022
27	2.25	December	0.0226	0	0.0311	0	0.1758	0	0.0226	0.2069	0	0.2349	0	0.3038
28	2.33	January	0.0226	0	0.0311	0	0.1759	0	0.0226	0.207	0	0.2362	0	0.3051
29	2.42	February	0.0226	0	0.0311	0	0.1759	0	0.0226	0.207	0	0.2363	0	0.3052
30	2.5	March	0.0226	0	0.0311	0	0.1759	0	0.0226	0.207	0	0.2364	0	0.3053
31	2.58	April	0.0226	0	0.0312	0	0.1773	0	0.0226	0.2085	0	0.2369	0	0.3062
32	2.67	May	0.0229	0	0.0315	0	0.1808	0	0.0229	0.2123	0	0.2407	0	0.3108
33	2.75	June	0.024	0	0.0322	0	0.1826	0	0.024	0.2148	0	0.2438	0	0.3145
34	2.83	July	0.0255	0	0.0326	0	0.1832	0	0.0255	0.2158	0	0.2458	0	0.3169
35	2.92	August	0.0267	0	0.0327	0	0.1834	0	0.0267	0.2161	0	0.2473	0	0.3186
36	3	September	0.0274	0	0.0328	0	0.1835	0	0.0274	0.2163	0	0.2486	0	0.3201
37	3.08	October	0.0279	0	0.0329	0	0.1836	0	0.0279	0.2165	0	0.2499	0	0.3215
38	3.17	November	0.0279	0	0.0329	0	0.1836	0	0.0279	0.2165	0	0.2509	0	0.3225
39	3.25	December	0.028	0	0.033	0	0.1838	0	0.028	0.2168	0	0.2522	0	0.3238
40	3.33	January	0.028	0	0.033	0	0.1839	0	0.028	0.2169	0	0.2531	0	0.3248
41	3.42	February	0.028	0	0.033	0	0.1839	0	0.028	0.2169	0	0.2532	0	0.3249
42	3.5	March	0.028	0	0.033	0	0.1839	0	0.028	0.2169	0	0.2532	0	0.3249
43	3.58	April	0.028	0	0.0331	0	0.1858	0	0.028	0.2189	0	0.2536	0	0.3257
44	3.67	May	0.0282	0	0.0334	0	0.1884	0	0.0282	0.2218	0	0.257	0	0.3297
45	3.75	June	0.0287	0	0.0339	0	0.1895	0	0.0287	0.2234	0	0.2595	0	0.3326
46	3.83	July	0.0298	0	0.0343	0	0.1899	0	0.0298	0.2242	0	0.2609	0	0.3343
47	3.92	August	0.0306	0	0.0344	0	0.1901	0	0.0306	0.2245	0	0.2621	0	0.3356
48	4	September	0.0311	0	0.0345	0	0.1901	0	0.0311	0.2246	0	0.2631	0	0.3367
49	4.08	October	0.0314	0	0.0345	0	0.1902	0	0.0314	0.2247	0	0.264	0	0.3377
50	4.17	November	0.0315	0	0.0345	0	0.1902	0	0.0315	0.2247	0	0.2648	0	0.3385
51	4.25	December	0.0315	0	0.0345	0	0.1903	0	0.0315	0.2248	0	0.2656	0	0.3393
52	4.33	January	0.0315	0	0.0345	0	0.1903	0	0.0315	0.2248	0	0.2659	0	0.3396
53	4.42	February	0.0315	0	0.0345	0	0.1903	0	0.0315	0.2248	0	0.2659	0	0.3396
54	4.5	March	0.0315	0	0.0345	0	0.1903	0	0.0315	0.2248	0	0.2659	0	0.3396
55	4.58	April	0.0315	0	0.0345	0	0.1903	0	0.0315	0.2248	0	0.2659	0	0.3396
56	4.67	May	0.0317	0	0.035	0	0.1947	0	0.0317	0.2297	0	0.2668	0	0.3415
57	4.75	June	0.0327	0	0.0359	0	0.197	0	0.0327	0.2329	0	0.2694	0	0.3449
58	4.83	July	0.0339	0	0.0362	0	0.1977	0	0.0339	0.2339	0	0.2711	0	0.3469
59	4.92	August	0.0347	0	0.0364	0	0.1978	0	0.0347	0.2342	0	0.272	0	0.348
60	5	September	0.0354	0	0.0364	0	0.1979	0	0.0354	0.2343	0	0.2729	0	0.349
61	5.08	October	0.0357	0	0.0364	0	0.1979	0	0.0357	0.2343	0	0.2736	0	0.3498
62	5.17	November	0.0358	0	0.0364	0	0.1979	0	0.0358	0.2343	0	0.2743	0	0.3505
63	5.25	December	0.0358	0	0.0365	0	0.198	0	0.0358	0.2345	0	0.2749	0	0.3511
64	5.33	January	0.0358	0	0.0365	0	0.198	0	0.0358	0.2345	0	0.2755	0	0.3517
65	5.42	February	0.0358	0	0.0365	0	0.198	0	0.0358	0.2345	0	0.2756	0	0.3518
66	5.5	March	0.0358	0	0.0365	0	0.198	0	0.0358	0.2345	0	0.2757	0	0.3519
67	5.58	April	0.0358	0	0.0365	0	0.198	0	0.0358	0.2345	0	0.276	0	0.3522
68	5.67	May	0.0359	0	0.0366	0	0.2002	0	0.0359	0.2368	0	0.2778	0	0.3545
69	5.75	June	0.0363	0	0.0369	0	0.2011	0	0.0363	0.238	0	0.2791	0	0.3561
70	5.83	July	0.0371	0	0.0371	0	0.2014	0	0.0371	0.2385	0	0.28	0	0.3572
71	5.92	August	0.0378	0	0.0371	0	0.2015	0	0.0378	0.2386	0	0.2808	0	0.3581
72	6	September	0.0384	0	0.0372	0	0.2015	0	0.0384	0.2387	0	0.2815	0	0.3589
73	6.08	October	0.0387	0	0.0372	0	0.2016	0	0.0387	0.2388	0	0.2822	0	0.3597
74	6.17	November	0.0388	0	0.0372	0	0.2016	0	0.0388	0.2388	0	0.2827	0	0.3602
75	6.25	December	0.0388	0	0.0372	0	0.2016	0	0.0388	0.2388	0	0.2833	0	0.3608
76	6.33	January	0.0388	0	0.0372	0	0.2016	0	0.0388	0.2388	0	0.2835	0	0.361
77	6.42	February	0.0388	0	0.0372	0	0.2016	0	0.0388	0.2388	0	0.2836	0	0.3611
78	6.5	March	0.0388	0	0.0372	0	0.2016	0	0.0388	0.2388	0	0.2836	0	0.3611
79	6.58	April	0.0388	0	0.0372	0	0.2026	0	0.0388	0.2398	0	0.2836	0	0.3613
80	6.67	May	0.0389	0	0.0374	0	0.2043	0	0.0389	0.2417	0	0.2846	0	0.3627

81	6.75	June	0.0393	0	0.0377	0	0.2059	0	0.0393	0.2436	0	0.2868	0	0.3653
82	6.83	July	0.0403	0	0.038	0	0.2065	0	0.0403	0.2445	0	0.288	0	0.3668
83	6.92	August	0.041	0	0.0381	0	0.2066	0	0.041	0.2447	0	0.2887	0	0.3676
84	7	September	0.0415	0	0.0381	0	0.2067	0	0.0415	0.2448	0	0.2893	0	0.3683
85	7.08	October	0.0417	0	0.0381	0	0.2067	0	0.0417	0.2448	0	0.2898	0	0.3689
86	7.17	November	0.0418	0	0.0381	0	0.2067	0	0.0418	0.2448	0	0.2903	0	0.3694
87	7.25	December	0.0418	0	0.0381	0	0.2068	0	0.0418	0.2449	0	0.2908	0	0.3699
88	7.33	January	0.0418	0	0.0381	0	0.2068	0	0.0418	0.2449	0	0.2911	0	0.3702
89	7.42	February	0.0418	0	0.0381	0	0.2068	0	0.0418	0.2449	0	0.2912	0	0.3703
90	7.5	March	0.0418	0	0.0381	0	0.2068	0	0.0418	0.2449	0	0.2912	0	0.3703
91	7.58	April	0.0418	0	0.0381	0	0.2069	0	0.0418	0.245	0	0.2912	0	0.3703
92	7.67	May	0.042	0	0.0384	0	0.2091	0	0.042	0.2475	0	0.2924	0	0.372
93	7.75	June	0.0424	0	0.0388	0	0.2099	0	0.0424	0.2487	0	0.294	0	0.3739
94	7.83	July	0.043	0	0.039	0	0.2101	0	0.043	0.2491	0	0.2949	0	0.375
95	7.92	August	0.0437	0	0.0391	0	0.2102	0	0.0437	0.2493	0	0.2955	0	0.3757
96	8	September	0.0441	0	0.0391	0	0.2102	0	0.0441	0.2493	0	0.296	0	0.3763
97	8.08	October	0.0444	0	0.0391	0	0.2102	0	0.0444	0.2493	0	0.2965	0	0.3768
98	8.17	November	0.0444	0	0.0391	0	0.2103	0	0.0444	0.2494	0	0.297	0	0.3773
99	8.25	December	0.0444	0	0.0391	0	0.2103	0	0.0444	0.2494	0	0.2975	0	0.3778
100	8.33	January	0.0444	0	0.0391	0	0.2103	0	0.0444	0.2494	0	0.2976	0	0.3779
101	8.42	February	0.0444	0	0.0391	0	0.2103	0	0.0444	0.2494	0	0.2976	0	0.3779
102	8.5	March	0.0444	0	0.0391	0	0.2103	0	0.0444	0.2494	0	0.2976	0	0.3779
103	8.58	April	0.0444	0	0.0391	0	0.2114	0	0.0444	0.2505	0	0.2976	0	0.3781
104	8.67	May	0.0446	0	0.0393	0	0.213	0	0.0446	0.2522	0	0.2987	0	0.3796
105	8.75	June	0.0447	0	0.0393	0	0.2134	0	0.0447	0.2527	0	0.3	0	0.381
106	8.83	July	0.0456	0	0.0394	0	0.2136	0	0.0456	0.253	0	0.3007	0	0.3819
107	8.92	August	0.0463	0	0.0395	0	0.2137	0	0.0463	0.2532	0	0.3013	0	0.3826
108	9	September	0.0468	0	0.0395	0	0.2137	0	0.0468	0.2532	0	0.3018	0	0.3832
109	9.08	October	0.047	0	0.0395	0	0.2137	0	0.047	0.2532	0	0.3022	0	0.3837
110	9.17	November	0.047	0	0.0395	0	0.2137	0	0.047	0.2532	0	0.3026	0	0.3841
111	9.25	December	0.047	0	0.0395	0	0.2137	0	0.047	0.2532	0	0.303	0	0.3845
112	9.33	January	0.047	0	0.0395	0	0.214	0	0.047	0.2535	0	0.3034	0	0.3849
113	9.42	February	0.047	0	0.0395	0	0.214	0	0.047	0.2535	0	0.3035	0	0.385
114	9.5	March	0.047	0	0.0395	0	0.214	0	0.047	0.2535	0	0.3035	0	0.385
115	9.58	April	0.047	0	0.0395	0	0.214	0	0.047	0.2535	0	0.3035	0	0.385
116	9.67	May	0.0471	0	0.0396	0	0.2162	0	0.0471	0.2558	0	0.3043	0	0.3863
117	9.75	June	0.0473	0	0.0397	0	0.217	0	0.0473	0.2567	0	0.3054	0	0.3876
118	9.83	July	0.048	0	0.0399	0	0.2174	0	0.048	0.2573	0	0.3062	0	0.3886
119	9.92	August	0.0486	0	0.0399	0	0.2175	0	0.0486	0.2575	0	0.3068	0	0.3893
120	10	September	0.049	0	0.04	0	0.2175	0	0.049	0.2575	0	0.3072	0	0.3898
121	10.08	October	0.0491	0	0.04	0	0.2175	0	0.0491	0.2575	0	0.3076	0	0.3902
122	10.17	November	0.0492	0	0.04	0	0.2175	0	0.0492	0.2575	0	0.3079	0	0.3905
123	10.25	December	0.0492	0	0.04	0	0.2175	0	0.0492	0.2575	0	0.3082	0	0.3908
124	10.33	January	0.0492	0	0.04	0	0.2175	0	0.0492	0.2575	0	0.3084	0	0.391
125	10.42	February	0.0492	0	0.04	0	0.2175	0	0.0492	0.2575	0	0.3084	0	0.391
126	10.5	March	0.0492	0	0.04	0	0.2175	0	0.0492	0.2575	0	0.3084	0	0.391
127	10.58	April	0.0492	0	0.04	0	0.2175	0	0.0492	0.2575	0	0.3085	0	0.3911
128	10.67	May	0.0493	0	0.0401	0	0.219	0	0.0493	0.2591	0	0.3096	0	0.3925
129	10.75	June	0.0498	0	0.0403	0	0.2196	0	0.0498	0.2599	0	0.3105	0	0.3936
130	10.83	July	0.0502	0	0.0403	0	0.2197	0	0.0502	0.26	0	0.311	0	0.3942

131	10.92	August	0.0507	0	0.0404	6	0.2197	0	0.0507	0.2601	0	0.3115	0	0.3948
132	11	September	0.0511	0	0.0404	6	0.2197	0	0.0511	0.2601	0	0.3119	0	0.3953
133	11.08	October	0.0513	0	0.0404	6	0.2198	0	0.0513	0.2602	0	0.3122	0	0.3956
134	11.17	November	0.0513	0	0.0404	6	0.2198	0	0.0513	0.2602	0	0.3125	0	0.3959
135	11.25	December	0.0513	0	0.0404	0	0.2198	0	0.0513	0.2602	0	0.3129	0	0.3963
136	11.33	January	0.0513	0	0.0404	0	0.2198	0	0.0513	0.2602	0	0.3132	0	0.3966
137	11.42	February	0.0513	0	0.0404	0	0.2198	0	0.0513	0.2602	0	0.3132	0	0.3966
138	11.5	March	0.0513	0	0.0404	0	0.2198	0	0.0513	0.2602	0	0.3132	0	0.3966
139	11.58	April	0.0513	0	0.0404	0	0.2201	0	0.0513	0.2605	0	0.3133	0	0.3968
140	11.67	May	0.0514	0	0.0405	0	0.2209	0	0.0514	0.2614	0	0.3143	0	0.398
141	11.75	June	0.0519	0	0.0406	6	0.2213	0	0.0519	0.2619	0	0.3151	0	0.3989
142	11.83	July	0.0525	0	0.0407	6	0.2215	0	0.0525	0.2622	0	0.3156	0	0.3996
143	11.92	August	0.053	0	0.0408	6	0.2215	0	0.053	0.2623	0	0.316	0	0.4001
144	12	September	0.0534	0	0.0408	6	0.2215	0	0.0534	0.2623	0	0.3164	0	0.4005
145	12.08	October	0.0536	0	0.0408	6	0.2215	0	0.0536	0.2623	0	0.3167	0	0.4009
146	12.17	November	0.0536	0	0.0408	6	0.2215	0	0.0536	0.2623	0	0.317	0	0.4012
147	12.25	December	0.0537	0	0.0408	6	0.2216	0	0.0537	0.2624	0	0.3173	0	0.4015
148	12.33	January	0.0537	0	0.0408	6	0.2216	0	0.0537	0.2624	0	0.3176	0	0.4018
149	12.42	February	0.0537	0	0.0408	6	0.2216	0	0.0537	0.2624	0	0.3176	0	0.4018
150	12.5	March	0.0537	0	0.0408	6	0.2216	0	0.0537	0.2624	0	0.3176	0	0.4018
151	12.58	April	0.0537	0	0.0408	6	0.2221	0	0.0537	0.2629	0	0.3177	0	0.402
152	12.67	May	0.0537	0	0.0409	6	0.2229	0	0.0537	0.2638	0	0.3189	0	0.4034
153	12.75	June	0.054	0	0.0411	6	0.2232	0	0.054	0.2643	0	0.3197	0	0.4043
154	12.83	July	0.0545	0	0.0412	6	0.2233	0	0.0545	0.2645	0	0.3202	0	0.4049
155	12.92	August	0.0549	0	0.0412	6	0.2233	0	0.0549	0.2645	0	0.3205	0	0.4053
156	13	September	0.0552	0	0.0413	6	0.2233	0	0.0552	0.2646	0	0.3209	0	0.4058
157	13.08	October	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3212	0	0.4061
158	13.17	November	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3215	0	0.4064
159	13.25	December	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3217	0	0.4066
160	13.33	January	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3218	0	0.4067
161	13.42	February	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3218	0	0.4067
162	13.5	March	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3218	0	0.4067
163	13.58	April	0.0554	0	0.0413	6	0.2234	0	0.0554	0.2647	0	0.3218	0	0.4067
164	13.67	May	0.0555	0	0.0414	6	0.225	0	0.0555	0.2664	0	0.3222	0	0.4074
165	13.75	June	0.056	0	0.0418	6	0.2259	0	0.056	0.2677	0	0.3232	0	0.4088
166	13.83	July	0.0567	0	0.0419	6	0.2261	0	0.0567	0.268	0	0.3238	0	0.4095
167	13.92	August	0.0571	0	0.042	6	0.2262	0	0.0571	0.2682	0	0.3242	0	0.41
168	14	September	0.0575	0	0.042	6	0.2262	0	0.0575	0.2682	0	0.3245	0	0.4104
169	14.08	October	0.0577	0	0.042	6	0.2262	0	0.0577	0.2682	0	0.3248	0	0.4107
170	14.17	November	0.0578	0	0.042	6	0.2262	0	0.0578	0.2682	0	0.325	0	0.4109
171	14.25	December	0.0578	0	0.042	6	0.2262	0	0.0578	0.2682	0	0.3253	0	0.4112
172	14.33	January	0.0578	0	0.042	6	0.2262	0	0.0578	0.2682	0	0.3255	0	0.4114
173	14.42	February	0.0578	0	0.042	6	0.2262	0	0.0578	0.2682	0	0.3255	0	0.4114
174	14.5	March	0.0578	0	0.042	6	0.2262	0	0.0578	0.2682	0	0.3256	0	0.4115
175	14.58	April	0.0578	0	0.042	6	0.2262	0	0.0578	0.2682	0	0.3257	0	0.4116
176	14.67	May	0.0578	0	0.0421	6	0.2271	0	0.0578	0.2692	0	0.3265	0	0.4126
177	14.75	June	0.0581	0	0.0422	6	0.2275	0	0.0581	0.2697	0	0.327	0	0.4133
178	14.83	July	0.0585	0	0.0423	6	0.2276	0	0.0585	0.2699	0	0.3274	0	0.4138
179	14.92	August	0.0589	0	0.0423	6	0.2276	0	0.0589	0.2699	0	0.3277	0	0.4141
180	15	September	0.0593	0	0.0423	6	0.2276	0	0.0593	0.2699	0	0.328	0	0.4145
181	15.08	October	0.0595	0	0.0423	6	0.2276	0	0.0595	0.2699	0	0.3283	0	0.4148
182	15.17	November	0.0595	0	0.0423	6	0.2276	0	0.0595	0.2699	0	0.3285	0	0.415
183	15.25	December	0.0595	0	0.0423	6	0.2277	0	0.0595	0.27	0	0.3288	0	0.4153
184	15.33	January	0.0595	0	0.0423	6	0.2277	0	0.0595	0.27	0	0.3288	0	0.4153
185	15.42	February	0.0595	0	0.0423	6	0.2277	0	0.0595	0.27	0	0.3289	0	0.4154
186	15.5	March	0.0595	0	0.0423	6	0.2277	0	0.0595	0.27	0	0.3289	0	0.4154
187	15.58	April	0.0595	0	0.0423	6	0.2281	0	0.0595	0.2704	0	0.3289	0	0.4155
188	15.67	May	0.0596	0	0.0424	6	0.2288	0	0.0596	0.2712	0	0.3293	0	0.4161
189	15.75	June	0.0599	0	0.0425	6	0.2296	0	0.0599	0.2721	0	0.3304	0	0.4174
190	15.83	July	0.0605	0	0.0427	6	0.2298	0	0.0605	0.2725	0	0.3309	0	0.4181

191	15.92	August	0.0609	0	0.0427	6	0.2299	0	0.0609	0.2726	0	0.3313	0	0.4185
192	16	September	0.0612	0	0.0427	6	0.2299	0	0.0612	0.2726	0	0.3315	0	0.4188
193	16.08	October	0.0614	0	0.0427	6	0.2299	0	0.0614	0.2726	0	0.3318	0	0.4191
194	16.17	November	0.0614	0	0.0427	6	0.2299	0	0.0614	0.2726	0	0.332	0	0.4193
195	16.25	December	0.0614	0	0.0427	6	0.2299	0	0.0614	0.2726	0	0.3323	0	0.4196
196	16.33	January	0.0614	0	0.0427	6	0.2299	0	0.0614	0.2726	0	0.3324	0	0.4197
197	16.42	February	0.0614	0	0.0427	6	0.2299	0	0.0614	0.2726	0	0.3324	0	0.4197
198	16.5	March	0.0614	0	0.0427	6	0.2299	0	0.0614	0.2726	0	0.3324	0	0.4197
199	16.58	April	0.0614	0	0.0427	6	0.23	0	0.0614	0.2727	0	0.3324	0	0.4197
200	16.67	May	0.0615	0	0.0429	6	0.231	0	0.0615	0.2739	0	0.333	0	0.4206
201	16.75	June	0.0618	0	0.0431	6	0.2314	0	0.0618	0.2745	0	0.3338	0	0.4215
202	16.83	July	0.0622	0	0.0432	6	0.2315	0	0.0622	0.2747	0	0.3343	0	0.4221
203	16.92	August	0.0626	0	0.0432	6	0.2315	0	0.0626	0.2747	0	0.3346	0	0.4225
204	17	September	0.063	0	0.0433	6	0.2316	0	0.063	0.2749	0	0.3348	0	0.4228
205	17.08	October	0.0631	0	0.0433	6	0.2316	0	0.0631	0.2749	0	0.3351	0	0.4231
206	17.17	November	0.0631	0	0.0433	6	0.2316	0	0.0631	0.2749	0	0.3353	0	0.4233
207	17.25	December	0.0631	0	0.0433	6	0.2316	0	0.0631	0.2749	0	0.3355	0	0.4235
208	17.33	January	0.0631	0	0.0433	6	0.2316	0	0.0631	0.2749	0	0.3356	0	0.4236
209	17.42	February	0.0631	0	0.0433	6	0.2316	0	0.0631	0.2749	0	0.3356	0	0.4236
210	17.5	March	0.0631	0	0.0433	6	0.2316	0	0.0631	0.2749	0	0.3356	0	0.4236
211	17.58	April	0.0631	0	0.0433	6	0.2322	0	0.0631	0.2755	0	0.3356	0	0.4237
212	17.67	May	0.0632	0	0.0433	6	0.233	0	0.0632	0.2763	0	0.3362	0	0.4245
213	17.75	June	0.0633	0	0.0434	6	0.2332	0	0.0633	0.2766	0	0.3369	0	0.4253
214	17.83	July	0.0639	0	0.0434	6	0.2333	0	0.0639	0.2767	0	0.3373	0	0.4258
215	17.92	August	0.0644	0	0.0435	6	0.2333	0	0.0644	0.2768	0	0.3376	0	0.4262
216	18	September	0.0648	0	0.0435	6	0.2333	0	0.0648	0.2768	0	0.3378	0	0.4264
217	18.08	October	0.0649	0	0.0435	6	0.2333	0	0.0649	0.2768	0	0.338	0	0.4267
218	18.17	November	0.0649	0	0.0435	6	0.2333	0	0.0649	0.2768	0	0.3382	0	0.4269
219	18.25	December	0.0649	0	0.0435	6	0.2333	0	0.0649	0.2768	0	0.3384	0	0.4271
220	18.33	January	0.0649	0	0.0435	6	0.2335	0	0.0649	0.277	0	0.3387	0	0.4274
221	18.42	February	0.0649	0	0.0435	6	0.2335	0	0.0649	0.277	0	0.3387	0	0.4274
222	18.5	March	0.0649	0	0.0435	6	0.2335	0	0.0649	0.277	0	0.3387	0	0.4274
223	18.58	April	0.0649	0	0.0435	6	0.2335	0	0.0649	0.277	0	0.3387	0	0.4274
224	18.67	May	0.0649	0	0.0435	6	0.2347	0	0.0649	0.2782	0	0.3392	0	0.4281
225	18.75	June	0.0651	0	0.0436	6	0.2352	0	0.0651	0.2788	0	0.3398	0	0.4288
226	18.83	July	0.0656	0	0.0437	6	0.2353	0	0.0656	0.279	0	0.3402	0	0.4294
227	18.92	August	0.066	0	0.0437	6	0.2354	0	0.066	0.2791	0	0.3405	0	0.4298
228	19	September	0.0663	0	0.0437	6	0.2354	0	0.0663	0.2791	0	0.3407	0	0.43
229	19.08	October	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3409	0	0.4302
230	19.17	November	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3411	0	0.4304
231	19.25	December	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3413	0	0.4306
232	19.33	January	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3414	0	0.4307
233	19.42	February	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3414	0	0.4307
234	19.5	March	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3414	0	0.4307
235	19.58	April	0.0664	0	0.0437	6	0.2354	0	0.0664	0.2791	0	0.3415	0	0.4308
236	19.67	May	0.0665	0	0.0438	6	0.2363	0	0.0665	0.2801	0	0.3421	0	0.4316
237	19.75	June	0.0668	0	0.0439	6	0.2366	0	0.0668	0.2805	0	0.3426	0	0.4322
238	19.83	July	0.0671	0	0.0439	6	0.2367	0	0.0671	0.2806	0	0.3429	0	0.4326
239	19.92	August	0.0675	0	0.0439	6	0.2367	0	0.0675	0.2806	0	0.3432	0	0.433
240	20	September	0.0678	0	0.044	6	0.2367	0	0.0678	0.2807	0	0.3434	0	0.4332

Total Rutting



11.G. *EverStress Raw Input and Output Files*

The raw input and output files that were used to run the EverStress analysis and that were created by the program can be found in the accompany Appendix folder under Appendix 11.G.

11.H. *Excel Output Files*

The Excel output files that were created from the raw output files can be found in the accompany Appendix folder under Appendix 11.H. This appendix contains both the EVERSTRESS OUTPUT DATA and EVERSTRESS OUTPUT DATA SUMMARIES.

12. References

[1] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.

[2] Zhanmin Zhang, Joseph P. Leidy, Izydor Kawa,W. Ronald Hudson. "Impact of Changing Traffic Characteristics and Environmental Conditions on Flexible Pavements." January 2000.

[3] Feng Wang and Randy B. Machemehl. "Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses." TRB 2006 Annual Meeting.

[4] ARA, Inc., ERES Consultants Division, *Guide for Mechanisitc-Emprical Design of New and Rehabilitated Pavement Structures*, National Cooperative Highway Research Program, 2004

[5] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".

[6] Timm, David H., Angela L. Priest and Thomas V. McEwen. "Design and Instrumentation of the Structural Pavement Experiment at the NCAT Test Track." National Center for Asphalt Technology. April 2004.

[7] Timm, David & Priest, Angela. "Dynamic Pavement Response Data Collection and Processing at the NCAT Test Track" NCAT Repot 04-03. June 2004.

[8] Baker, Harris, Michael R Buth, and David A Van Duesen. "Load Response Instrumentation Installation and Testing Procedures." March 1994.

[9] Sharp, R.S., Galal, K.A., Elfino, M.K. "*Using Fiber-Optic Sensor Technology to Measure Strains Under the Asphalt Layer of a Flexible Pavement Structure*," Virginia Transportation Research Council, August 2006.

[10] Salman A. Bhutta1, Imad L. Al-Qadi2, and Thomas L. Brandon. "In-Situ Measurements of Flexible Pavement's Response to Vehicular Loading."

[11] Feng Wang and Randy B. Machemehl. "Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses." TRB 2006 Annual Meeting.

[12] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. "Investigation of Tire Contact Stress Distributions on Pavement Response."Journal of Transportation Engineering. March/April 2002.

[13] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".

[14] Imad L. Al-Qadia, Amara Loulizib, Mostafa Elseific, and Samer Lahouard. "The Virginia Smart Road: The Impact of Pavement Instrumentation on Understanding Pavement Performance."

[15] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. "Investigation of Tire Contact Stress Distributions on Pavement Response."Journal of Transportation Engineering. March/April 2002.

[16] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".

[17] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.

[18] Rong Luo, and Jorge A. Prozzi. "Effect of measured 3-D Tire-Pavement Contact Stress on Pavement Response at Asphalt Surface."

[19] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.

[20] ARA, Inc., ERES Consultants Division, *Guide for Mechanisitc-Emprical Design of New and Rehabilitated Pavement Structures*, National Cooperative Highway Research Program, 2004

[21] Imad L. Al-Qadia, Amara Loulizib, Mostafa Elseific, and Samer Lahouard. "The Virginia Smart Road: The Impact of Pavement Instrumentation on Understanding Pavement Performance."
[22] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. "Investigation of Tire Contact Stress Distributions on Pavement Response."Journal of Transportation Engineering. March/April 2002.
[23] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.
[24] Rong Luo, and Jorge A. Prozzi. "Effect of measured 3-D Tire-Pavement Contact Stress on Pavement Response at Asphalt Surface."
[25] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.
[26] Imad L. Al-Qadia, Amara Loulizib, Mostafa Elseific, and Samer Lahouard. "The Virginia Smart Road: The Impact of Pavement Instrumentation on Understanding Pavement Performance."
[27] Angel Mateos, Mark B. Snyder. "Impact of Changing Traffic Characteristics and Environmental Conditions on Flexible Pavements." August 1 2002.
[28] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.
[29] Randy B. Machemehl, Feng Wang, and Jorge A. Prozzi. "Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses."
[30] Wang, F., and Machemehl Ph.D., P.E., R. B., Mechanistic-Empirical Study of Effects of Truck Tire Pressure on Pavement Using Measured Tire-Pavement Contact Stress Data, TRB Annual Meeting CD Rom, 2006
[31] Rong Luo, and Jorge A. Prozzi. "Effect of measured 3-D Tire-Pavement Contact Stress on Pavement Response at Asphalt Surface."
[32] De Beer, M., C. Fisher, and Fritz J. Jooste. "Determination of Pneumatic Tire/Pavement Interface Contact Stresses Under Moving Loads and Some Effects on Pavements With Thin Asphalt Surfacing Layers." Division of Roads and Transport Technology, CSIR.
[33] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. "Investigation of Tire Contact Stress Distributions on Pavement Response."Journal of Transportation Engineering. March/April 2002.
[34] Rong Luo, and Jorge A. Prozzi. "Effect of measured 3-D Tire-Pavement Contact Stress on Pavement Response at Asphalt Surface."
[35] De Beer, M., C. Fisher, and Fritz J. Jooste. "Determination of Pneumatic Tire/Pavement Interface Contact Stresses Under Moving Loads and Some Effects on Pavements With Thin Asphalt Surfacing Layers." Division of Roads and Transport Technology, CSIR.
[36] Randy B. Machemehl, Feng Wang, and Jorge A. Prozzi. "Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses."
[37] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. "Investigation of Tire Contact Stress Distributions on Pavement Response."Journal of Transportation Engineering. March/April 2002.
[38] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. "Investigation of Tire Contact Stress Distributions on Pavement Response."Journal of Transportation Engineering. March/April 2002.
[39] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.
[40] Zhanmin Zhang, Joseph P. Leidy, Izydor Kawa,W. Ronald Hudson. "Impact of Changing Traffic Characteristics and Environmental Conditions on Flexible Pavements." January 2000.
[41] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.

[42] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".
[43] Gucunski, Nenad, Sameh Zaghloul, Rambod Hadidi, Ali Maher and Tony Chmiel. "Pavement Evaluation and Development of Seasonal and Temperature Adjustment Models Using Seismis Pavement Analyzer (SPA)." http://www.dot.state.fl.us/statematerialsoffice/geotechnical/conference/materials/gucunski-zaghloul-hadidi-maher-chmiel.pdf.
[44] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".
[45] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".
[46] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".
[47] Gucunski, Nenad, Sameh Zaghloul, Rambod Hadidi, Ali Maher and Tony Chmiel. "Pavement Evaluation and Development of Seasonal and Temperature Adjustment Models Using Seismis Pavement Analyzer (SPA)." http://www.dot.state.fl.us/statematerialsoffice/geotechnical/conference/materials/gucunski-zaghloul-hadidi-maher-chmiel.pdf.
[48] Stoffels, Shelley M, Mansour Solaimanian, Dennis Morian and Hao Yin. "Field Instrumentation and Testing Data from Pennsylvania's Superpave In-Situ Stress/Strain Investigation (DRAFT FOR REVIEW)".
[49] Timm, David H., Angela L. Priest and Thomas V. McEwen. "Design and Instrumentation of the Structural Pavement Experiment at the NCAT Test Track." National Center for Asphalt Technology. April 2004.
[50] Timm, David & Priest, Angela. "Dynamic Pavement Response Data Collection and Processing at the NCAT Test Track" NCAT Repot 04-03. June 2004.
[51] Imad L. Al-Qadia, Amara Loulizib, Mostafa Elseific, and Samer Lahouard. "The Virginia Smart Road: The Impact of Pavement Instrumentation on Understanding Pavement Performance."
[52] Baker, Harris, Michael R Buth, and David A Van Duesen. "Load Response Instrumentation Installation and Testing Procedures." March 1994.
[53] Gucunski, Nenad, Sameh Zaghloul, Rambod Hadidi, Ali Maher and Tony Chmiel. "Pavement Evaluation and Development of Seasonal and Temperature Adjustment Models Using Seismis Pavement Analyzer (SPA)." http://www.dot.state.fl.us/statematerialsoffice/geotechnical/conference/materials/gucunski-zaghloul-hadidi-maher-chmiel.pdf.
[54] "Load Testing of Instrumented Pavement Sections." http://www.mnroad.dot.state.mn.us/research/pdf/1999MRRDOC004.pdf. University of Minnesota, Department of Civil Engineering. 16 February 1999.
[55] Sharp, R.S., Galal, K.A., Elfino, M.K. "*Using Fiber-Optic Sensor Technology to Measure Strains Under the Asphalt Layer of a Flexible Pavement Structure*," Virginia Transportation Research Council, August 2006.
[56] ARA, Inc., ERES Consultants Division, *Guide for Mechanisitc-Emprical Design of New and Rehabilitated Pavement Structures*, National Cooperative Highway Research Program, 2004
[57] Salman A. Bhutta1, Imad L. Al-Qadi2, and Thomas L. Brandon. "In-Situ Measurements of Flexible Pavement's Response to Vehicular Loading."
[58] Zhanmin Zhang, Joseph P. Leidy, Izydor Kawa,W. Ronald Hudson. "Impact of Changing Traffic Characteristics and Environmental Conditions on Flexible Pavements." January 2000.
[59] Angel Mateos, Mark B. Snyder. "Impact of Changing Traffic Characteristics and Environmental Conditions on Flexible Pavements." August 1 2002.
[60] Randy B. Machemehl, Feng Wang, and Jorge A. Prozzi. "Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses."
[61] Feng Wang and Randy B. Machemehl. "Development of Quick Solutions for Prediction of Critical Asphalt Pavement Responses due to Measured Tire-Pavement Contact Stresses." TRB 2006 Annual Meeting.
[62] Wang, F., and Machemehl Ph.D., P.E., R. B., Mechanistic-Empirical Study of Effects of Truck Tire Pressure on Pavement Using Measured Tire-Pavement Contact Stress Data, TRB Annual Meeting CD Rom, 2006

[63] Rong Luo, and Jorge A. Prozzi. “Effect of measured 3-D Tire-Pavement Contact Stress on Pavement Response at Asphalt Surface.”
[64] De Beer, M., C. Fisher, and Fritz J. Jooste. “Determination of Pneumatic Tire/Pavement Interface Contact Stresses Under Moving Loads and Some Effects on Pavements With Thin Asphalt Surfacing Layers.” Division of Roads and Transport Technology, CSIR.
[65] Siddharthan ,Raj V., N. Krishnamenon, Mohey El-Mously, and Peter E. Sebaaly. “Investigation of Tire Contact Stress Distributions on Pavement Response.”Journal of Transportation Engineering. March/April 2002.
[66] ASTM StandardE1318-00e1 Standard Specification for Highway Weigh-in-Motion (WIM) Systems with User Requirements and Test Methods, ASTM International, West Conshohocken, PA, www.astm.org.
[67] “Weigh In Motion Handbook, Section 3,” Center for Transportation Research and Education, Iowa State University, Ames, Iowa. 1996-2007.
[68] “Weigh In Motion Handbook, Section 3,” Center for Transportation Research and Education, Iowa State University, Ames, Iowa. 1996-2007.
[69] “Weigh In Motion Benchmarking,” Pennsylvania Department of Transportation Bureau of Planning and Research. November 2002.
[70] Conron, C.E., In-Service Evaluation of Flexible Pavement Guilford, ME: A Study of the Effects of Environment and Traffic on Pavement Response, WPI, Pending.
[71] “Analysis of Pavement Response Data and Use of Nondestructive Testing for Improving Pavement Design and Adoption of Mechanistic-Empirical Pavement Design Procedure Using the Gilford Route 15 Instrumented Pavement Test Section.” Rajib B. Mallick, Worcester Polytechnic Institute. August 8th 2006.
[72] “Analysis of Pavement Response Data and Use of Nondestructive Testing for Improving Pavement Design and Adoption of Mechanistic-Empirical Pavement Design Procedure Using the Gilford Route 15 Instrumented Pavement Test Section.” Rajib B. Mallick, Worcester Polytechnic Institute. August 8th 2006.
[73] “Analysis of Pavement Response Data and Use of Nondestructive Testing for Improving Pavement Design and Adoption of Mechanistic-Empirical Pavement Design Procedure Using the Gilford Route 15 Instrumented Pavement Test Section.” Rajib B. Mallick, Worcester Polytechnic Institute. August 8th 2006.
[74] “Analysis of Pavement Response Data and Use of Nondestructive Testing for Improving Pavement Design and Adoption of Mechanistic-Empirical Pavement Design Procedure Using the Gilford Route 15 Instrumented Pavement Test Section.” Rajib B. Mallick, Worcester Polytechnic Institute. August 8th 2006.
[75] “Analysis of Pavement Response Data and Use of Nondestructive Testing for Improving Pavement Design and Adoption of Mechanistic-Empirical Pavement Design Procedure Using the Gilford Route 15 Instrumented Pavement Test Section.” Rajib B. Mallick, Worcester Polytechnic Institute. August 8th 2006.
[76] “A Policy on Geometric Design of Highways and Streets.” American Society of State Highway and Transportation Officials. 1984.
[77] “Report 505: Review of Truck Characteristics as Factors in Roadway Design.” National Cooperative Highway Research Program. 2003.

[78] “A Policy on Geometric Design of Highways and Streets.” American Society of State Highway and Transportation Officials. 1984.
[79] “Report 505: Review of Truck Characteristics as Factors in Roadway Design.” National Cooperative Highway Research Program. 2003.
[80] Mallick, Rajib B,and Sudip Bhattacharjee. “An Evaluation Of Performance And Life Cycle Cost Of Hot Mix Asphalt (Hma) Pavements Of Different Thickness.” Department of Civil and Environmental Engineering, Worcester Polytechnic Institute. November 2005.
[81] Nanagiri, Yamini. “Determination of Laboratory Resilient Modulus for Subgrade Soils.” Fall, 2001.